LAKE ARTHUR, GRAND LAKE, AND GULF INTRACOASTAL WATERWAY TMDLS FOR DISSOLVED OXYGEN, NUTRIENTS, AND AMMONIA

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LAKE ARTHUR, GRAND LAKE, AND GULF INTRACOASTAL WATERWAY TMDLS FOR DISSOLVED OXYGEN, NUTRIENTS, AND AMMONIA

SUBSEGMENTS 050402, 050701, 050602, AND 050702

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EXECUTIVE SUMMARY

Section 303(d) of the Federal Clean Water Act requires states to identify waterbodies that are not meeting water quality standards and to develop total maximum daily pollutant loads for those waterbodies. A total maximum daily load (TMDL) is the amount of pollutant that a waterbody can assimilate without exceeding the established water quality standard for that pollutant. Through a TMDL, pollutant loads can be distributed or allocated to point sources and nonpoint sources discharging to the waterbody. This report presents TMDLs that have been developed for dissolved oxygen (DO), nutrients, and ammonia for 4 subsegments in the lower Mermentau basin in southern Louisiana.

The 4 subsegments for which TMDLs were developed are:

050402 – Lake Arthur
050602 – Gulf Intracoastal Waterway from Calcasieu basin to Mermentau River
050701 – Grand Lake
050702 – Gulf Intracoastal Waterway from Mermentau River to Leland Bowman Lock

These subsegments are in a coastal area where the hydraulic regime is significantly affected by water levels in the Gulf of Mexico and by operation of several Corps of Engineers control structures. Flow reversals are common during low flow conditions. These waterbodies receive drainage from the Mermentau River basin, which is over 3000 square miles in size and is heavily agricultural. There are relatively few point source discharges in these 4 subsegments.

Each of these 4 subsegments was listed on the Modified Court Ordered 303(d) List for Louisiana as not fully supporting the designated use of propagation of fish and wildlife and was ranked as priority #1 for TMDL development. None of these 4 subsegments was included on the 1998 303(d) list, but all 4 subsegments were later added to the list based on LDEQ assessment data collected during June – December 1998. The causes for impairment cited in the 303(d) list included organic enrichment/low DO for all 4 subsegments, nutrients for 3 of the subsegments (all except 050602), and ammonia for 1 subsegment (050402). The water quality standard for DO is 5 mg/L year round for all 4 subsegments.

A water quality model (LA-QUAL) was set up to simulate DO, CBOD, ammonia nitrogen, and organic nitrogen in the 4 subsegments. The model was calibrated using LDEQ assessment data collected during June – December 1998, data from FTN's synoptic survey in September 2000, and other various information obtained from LDEQ, Corps of Engineers, and USGS. There were no intensive survey data available for the primary waterbodies in these 4 subsegments. The projection simulation was run at critical flows and temperatures to address seasonality as required by the Clean Water Act. Reductions of existing loads from both point sources and nonpoint sources were required for the projection simulation to show the DO standard of 5 mg/L being maintained. In general, the modeling in this study was consistent with guidance in the Louisiana TMDL Technical Procedures Manual.

TMDLs for oxygen demanding substances (CBOD, ammonia nitrogen, organic nitrogen, and sediment oxygen demand) were calculated using the results of the projection simulation. Both implicit and explicit margins of safety were included in the TMDL calculations. The nutrient TMDLs were developed based on Louisiana's water quality standard for nutrients, which states that "the naturally occurring range of nitrogen to phosphorus ratios shall be maintained". The nutrient TMDLs were calculated using allowable nitrogen loadings from the projection simulation and applying a naturally occurring nitrogen to phosphorus ratio to determine the allowable phosphorus loadings. Because Louisiana does not have a water quality standard for ammonia, the ammonia TMDLs were based on: 1) maintaining the DO standard, and 2) not exceeding published EPA criteria for ammonia toxicity.

The TMDLs for these 4 subsegments include wasteload allocations for 2 specific point source discharges plus an additional wasteload allocation for all of the other point sources with minor oxygen demanding discharges within the 4 subsegments. A treatment upgrade will be required for one of the point source discharges (City of Kaplan WWTP). Nonpoint source reductions of 40% to 50% are required for most of the waterbodies in these 4 subsegments to meet the water quality standard for DO. The exception to this is Sledge Canal, which is a small, sluggish canal that receives the discharge from the City of Kaplan WWTP and flows into the Gulf Intracoastal Waterway (subsegment 050702). The model showed that, even with Kaplan upgrading its treatment to 10 mg/L $CBOD_5$ and 2 mg/L ammonia nitrogen, a 99% reduction of nonpoint source loads would be required to meet the DO standard of 5 mg/L in Sledge Canal. The existing DO standard of 5 mg/L for subsegment 050702 does not appear to be achievable for waterbodies such as Sledge Canal.

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1.0 INTRODUCTION

This report presents total maximum daily loads (TMDLs) for dissolved oxygen (DO), nutrients, and ammonia for the 4 subsegments listed in Table 1.1. Each of these 4 subsegments was listed on the February 29, 2000 Modified Court Ordered 303(d) List for Louisiana (EPA 2000) as not fully supporting the designated use of propagation of fish and wildlife. None of these subsegments was included on the 1998 303(d) list, but all 4 subsegments were later added to the list based on LDEQ assessment data collected during June – December 1998. The suspected sources and suspected causes for impairment in the 303(d) list are included in Table 1.1. All 4 subsegments were ranked as priority #1 for TMDL development. The TMDLs in this report were developed in accordance with the Section 303(d) of the Federal Clean Water Act and EPA's regulations at 40 CFR 130.7. The 303(d) listings for other pollutants in these subsegments are being addressed by EPA and the Louisiana Department of Environmental Quality (LDEQ) in other documents.

The purpose of a TMDL is to determine the pollutant loading that a waterbody can assimilate without exceeding the water quality standard for that pollutant and to establish the load reduction that is necessary to meet the standard in a waterbody. The TMDL is the sum of the wasteload allocation (WLA), the load allocation (LA), and a margin of safety (MOS). The WLA is the load allocated to point sources of the pollutant of concern, and the load allocation is the LA to nonpoint sources. The margin of safety is a percentage of the TMDL that accounts for the uncertainty associated with the model assumptions, data inadequacies, and future growth.

2.0 STUDY AREA DESCRIPTION

2.1 General Information

The 4 subsegments in the study area are part of the lower portion of the Mermentau River basin in southern Louisiana (see map in Appendix A). During high flow conditions, much of the flow through these waterbodies originates from upstream areas in the Mermentau River basin (as opposed to local runoff from within these subsegments). Major inflows to these 4 subsegments include the Mermentau River at the upper end of Lake Arthur (1702 square miles of drainage area) and Bayou Lacassine at the Gulf Intracoastal Waterway (398 square miles of drainage area; USGS, 1971). There are numerous small canals and streams that are connected to either Grand Lake or the Gulf Intracoastal Waterway (GIWW), particularly between the Mermentau River and Leland Bowman Lock. Many of these small canals were dug for drainage or for navigation of barges or other small commercial vessels. Land use data for the study area is shown in Table 2.1.

Table 1.1. Summary of 303(d) listing of the 4 subsegments in the study area (EPA 2000).

Subsegment Number	Waterbody Description	Suspected Sources	Suspected Causes	Priority Ranking (1 = highest)
050402	Lake Arthur and Lower Mermentau River to Grand Lake	Minor municipal point source Non-irrigated crop production Irrigated crop production Petroleum activities Septic tanks Flow regulations/modifications	Organic enrichment/low DO Oil & grease Suspended solids Turbidity Ammonia Nutrients	1
050602	GIWW from the Calcasieu River Basin Boundary to the Mermentau River	Non-irrigated crop production Irrigated crop production Petroleum activities Flow regulations/modifications	Organic enrichment/low DO Oil & grease Suspended solids Turbidity	1
050701	Grand Lake	Minor industrial point sources Non-irrigated crop production Irrigated crop production Petroleum activities Flow regulations/modifications	Organic enrichment/low DO Oil & grease Suspended solids Turbidity Pesticides Nutrients	1
050702	GIWW from the Mermentau River to Leland Bowman Lock	Minor industrial point sources Package plants (small flows) Non-irrigated crop production Irrigated crop production Petroleum activities Flow regulations/modifications Spills Industrial Municipal	Organic enrichment/low DO Oil & grease Suspended solids Turbidity Pesticides Nutrients Mercury	1

Table 2.1. Land uses in the study area based on GAP data (USGS, 1998).

Land Use Type	% of Total Area			
	050402	**050602**	**050701**	**050702**
Urban	3.8%	0.4%	0.1%	2.1%
Extractive	0.0%	0.0%	0.0%	0.0%
Agricultural	57.8%	2.8%	1.1%	65.2%
Forest Land	6.0%	1.0%	1.0%	3.1%
Water	20.5%	23.5%	46.0%	12.4%
Wetland	11.9%	72.3%	51.8%	17.2%
Barren Land	0.0%	0.0%	0.0%	0.0%
TOTAL	100.0%	100.0%	100.0%	100.0%

During low flows, the hydraulic regime of the waterbodies in the 4 subsegments in the study area is affected by water levels in the Gulf of Mexico and by operation of several Corps of Engineers control structures. The Corps of Engineers has built 5 navigation locks and control structures in the lower Mermentau River basin (Calcasieu Lock, Leland Bowman Lock, Freshwater Bayou Lock, Catfish Point Control Structure, and Schooner Bayou Control Structure). The locations of these structures can be seen on the map in Appendix A. These structures were built to minimize salinity intrusion into Grand Lake, Lake Arthur, and other canals and streams in the lower Mermentau River basin. Before these structures were built, Grand Lake and White Lake and other nearby waterbodies were brackish, but now these waterbodies are considered freshwater systems. It is not uncommon for water levels to be higher on the downstream side of the structures (i.e., the Gulf side) than on the inland side, especially during times of low rainfall and high water usage for irrigation. During these conditions, the structures remain closed except to allow boat traffic to pass through the structures (USACE, 1998). These conditions create flow reversals in the lower Mermentau system with flows in the upstream direction measured by several USGS gages located upstream of Lake Arthur (e.g., Mermentau River at Mermentau, Bayou Queue de Tortue at Riceville).

2.2 Water Quality Standards

The numeric water quality standards and designated uses for these subsegments are shown in Table 2.2. The primary numeric standard for the TMDLs presented in this report is the DO standard of 5 mg/L year round.

For nutrients, there are no specific numeric criteria, but there is a narrative standard that states "The naturally occurring range of nitrogen-phosphorus ratios shall be maintained.... Nutrient concentrations that produce aquatic growth to the extent that it creates a public nuisance or interferes with designated water uses shall not be added to any surface waters." (LDEQ 2000a).

Table 2.2. Water quality standards and designated uses (LDEQ 2000a).

Subsegment Number	050402	050602	050701	050702
Waterbody Description	Lake Arthur	GIWW from Calcasieu Basin to Mermentau River	Grand Lake	GIWW from Mermentau River to Leland Bowman Lock
Designated Uses	ABC	ABCF	ABCF	ABCF
Criteria:				
Chloride	90 mg/L	250 mg/L	250 mg/L	250 mg/L
Sulfate	30 mg/L	75 mg/L	75 mg/L	75 mg/L
DO	5 mg/L	5 mg/L	5 mg/L	5 mg/L
pH	6.0 – 8.5	6.5 – 9.0	6.5 – 9.0	6.0 – 9.0
Temperature	32 °C	32 °C	32 °C	32 °C
TDS	260 mg/L	500 mg/L	500 mg/L	500 mg/L

USES: A – primary contact recreation; B – secondary contact recreation; C – propagation of fish and wildlife; D – drinking water supply; E – oyster propagation; F – agriculture; G – outstanding natural resource water; L – limited aquatic life and wildlife use.

In addition, LDEQ issued a declaratory ruling on April 29, 1996, concerning this language and stated, "That DO directly correlates with overall nutrient impact is a well-established biological and ecological principle. Thus, when the LDEQ maintains and protects DO, the LDEQ is in effect also limiting and controlling nutrient concentrations and impacts." DO serves as the indicator for the water quality criteria and for assessment of use support. For the TMDLs in this report, the nutrient loading required to maintain the DO standard is the nutrient TMDL.

For ammonia, there are no specific numeric criteria in the Louisiana water quality standards. However, the impacts of ammonia are usually controlled indirectly by maintaining the DO standard (as discussed above for nutrients). Also, the ammonia TMDL calculations in this report included checking to make sure that instream ammonia concentrations were below EPA's published ammonia criteria for toxicity (EPA 1999).

2.3 Identification of Sources

2.3.1 Point Sources

Lists of NPDES permits that were identified in or near each subsegment in the study area are included in Appendix B. These permits were identified by searching two sources of information. The primary source was a listing of all the permits in the Mermentau basin (basin number 05) from the LDEQ static database. The secondary source was a listing of all the permits in the Mermentau basin (hydrologic units 08080101 and 08080102) from EPA's Permit Compliance System (PCS) on the EPA website. The only permits in Appendix B that were not included in the LDEQ static database were: Vastar Resources, Lower Cameron Hospital SVC, and Conoco Inc. All of the information concerning permit parameters and design flow in Appendix B was obtained by manually retrieving hard copies of permit files from LDEQ's file room.

Facilities without oxygen demanding parameters in their permit were assumed to exert a negligible oxygen demand in the receiving stream; therefore, these facilities were excluded from any further consideration in these TMDLs. All of the facilities with oxygen demanding parameters in their permit were included in the TMDL calculations, but only 2 of them were considered large enough to be modeled explicitly. The remaining oxygen demanding discharges were included in the model implicitly by considering their oxygen demand as part of the nonpoint source loading into the system.

The point sources that were explicitly included in the model were the Lake Arthur Sewage Treatment Plant (STP), and the City of Kaplan STP. The approximate locations of these dischargers are shown in Appendix A. The permit records, permit applications, and Discharge Monitoring Reports (DMRs) for these facilities were examined and appropriate input information for the calibration and projection modeling runs was derived to the maximum extent possible.

Relevant information for the discharges explicitly included in the model is listed below:

	Lake Arthur STP	City of Kaplan STP
Permit number:	LA0020133	LA0096440
Receiving stream:	Unnamed canal to Lake Arthur	Sledge Canal to GIWW
Design flow:	0.75 mgd	1.12 mgd
Permit limits:	10 mg/L BOD_5 (monthly avg.)	30 mg/L BOD_5 (monthly avg.)
Treatment:	High rate trickling filter	Trickling filter

2.3.2 Nonpoint Sources

Several nonpoint sources were cited as suspected sources of impairment in the 303(d) list (Table 1.1). These nonpoint sources include non-irrigated crop production, irrigated crop production, petroleum activities, septic tanks, and flow regulations/modifications.

2.4 Previous Data and Studies

Listed below are previous water quality data and studies in or near the subsegments in the study area. Locations of selected LDEQ ambient monitoring stations are shown in Appendix A.

1. Twice monthly data collected by LDEQ for “Mermentau River (Lower)” (station 655) for mid-June to December 1998. This station is located at the Lacassine National Wildlife Refuge Headquarters.
2. Twice monthly data collected by LDEQ for “Mermentau River” (station 654) for mid-June to December 1998. This station is near the town of Lake Arthur at the Highway 14 bridge.
3. Twice monthly data collected by LDEQ for “Grand Lake near Talen’s Landing” (station 659) for mid-June to December 1998.

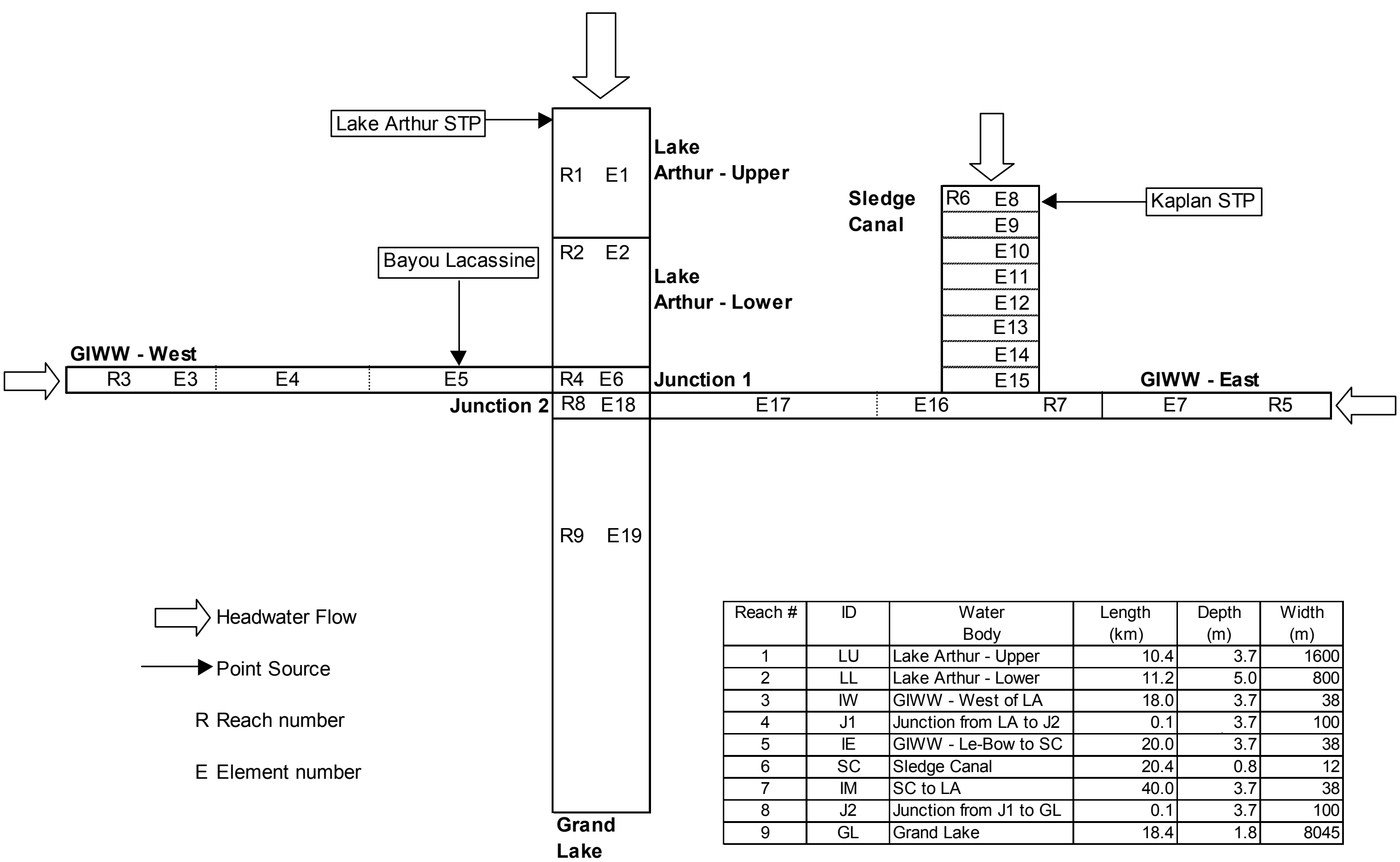
4. Twice monthly data collected by LDEQ for "Intracoastal Waterway" (station 657) for mid-June to December 1998.
5. Twice monthly data collected by LDEQ for "Intracoastal Waterway at mile 170" (station 660) for mid-June to December 1998.
6. Twice monthly data collected by LDEQ for "Vermilion River Cutoff" (station 78) for mid-June to December 1998.
7. Twice monthly data collected by LDEQ for "Intracoastal Waterway" (station 679) for mid-June to December 1998.
8. Twice monthly data collected by LDEQ for "Bayou Lacassine near Lake Arthur, Louisiana" (station 098) for March 1978 to December 1998.
9. Monthly data collected by LDEQ for "Intracoastal Waterway west of Boones Corner" (station 851) for January to December 1999.
10. Twice monthly to quarterly data collected by USGS at the Mermentau River at Mermentau, LA (station 08012150) for March 1979 to September 1993 and July 1998 to August 2000.
11. Monthly to weekly data collected by the USGS in the Mermentau River near the Lacassine National Wildlife Refuge headquarters (station 08012420) for January 1978 to September 1982.
12. Semi-monthly data collected at the intersection of Bayou Lacassine and the GIWW from 1988 to 1999. These data were collected by Lacassine National Wildlife Refuge personnel.
13. A fish survey of 2 canals in Lake Arthur. One canal was the unnamed canal downstream of the Lake Arthur STP, and the other was a reference canal just downstream of the Lake. The survey was conducted in October and December 1992 (LDEQ 1994).
14. A reconnaissance and intensive survey of the unnamed canal downstream of the town of Lake Arthur STP. The reconnaissance was performed by LDEQ in July 1991 (LDEQ 1991) and the intensive survey was performed by LDEQ in September 1992 (LDEQ 1993).
15. DO TMDL for Unnamed Canal at Lake Arthur Louisiana based on the 1992 intensive survey (USL 1997).
16. DO TMDL for the Mermentau River upstream of Lake Arthur (LDEQ 1999).
17. DO TMDL for Bayou Lacassine (FTN, 2000a).
18. Dissolved Oxygen Use Attainability Analysis for the Mermentau River Basin (LDEQ 1998).

3.0 CALIBRATION OF WATER QUALITY MODEL

3.1 Model Setup

In order to evaluate the linkage between pollutant sources and water quality, a computer simulation model was used. The model used for these TMDLs was LA-QUAL (version 3.02), which was selected because it includes the relevant physical, chemical, and biological processes and it has been used successfully in the past for other TMDLs in Louisiana. The LA-QUAL model was set up to simulate organic nitrogen, ammonia nitrogen, ultimate carbonaceous biochemical oxygen demand (CBODu), and DO. Phosphorus and algae were not simulated because algae do not appear to have significant impacts on DO in these subsegments.

A vector diagram of the model is shown in Figure 3.1 below. The vector diagram shows the reach/element design and the location of the modeled inflows and point sources.



Reach #	ID	Water Body	Length (km)	Depth (m)	Width (m)
1	LU	Lake Arthur - Upper	10.4	3.7	1600
2	LL	Lake Arthur - Lower	11.2	5.0	800
3	IW	GIWW - West of LA	18.0	3.7	38
4	J1	Junction from LA to J2	0.1	3.7	100
5	IE	GIWW - Le-Bow to SC	20.0	3.7	38
6	SC	Sledge Canal	20.4	0.8	12
7	IM	SC to LA	40.0	3.7	38
8	J2	Junction from J1 to GL	0.1	3.7	100
9	GL	Grand Lake	18.4	1.8	8045

Figure 3.1. Vector diagram for LA-QUAL model.

As shown in Figure 3.1, the main "branches" of the model are:

1. Lake Arthur
2. GIWW West (from the Calcasieu basin to the Mermentau River)
3. Sledge Canal
4. GIWW East (from the Mermentau River to Leland Bowman Lock)
5. Grand Lake

Each of the main branches in the model represents the primary waterbody in one of the 4 subsegments in the study area, except for the Sledge Canal. The Sledge Canal was included in this model because it is the receiving stream for discharges from the City of Kaplan STP, whose discharge was considered large enough to be explicitly included in the model (see Section 2.3.1).

In general, the number of separate reaches and elements within each branch was minimized. This was done based on expected uniformity of hydraulics and water quality. For example, the entire area of Grand Lake was represented as one element in the model because: 1) water quality data are only available at one location and there is no evidence to suggest significant water quality variation throughout the lake, and 2) the only depth information that is available indicates that the depth of the lake is fairly uniform. The Lake Arthur branch was divided into multiple reaches only because the depth and width are different in the upper and lower portions of that subsegment. The Sledge Canal was divided into smaller elements because there will likely be some variation in water quality along the length of the canal due to the point source discharge.

Also, two small junction elements had to be included in the model to represent 4 of the branches (Lake Arthur, GIWW West, GIWW East, and Grand Lake) intersecting at one location.

3.2 Calibration Period

An intensive field survey was not performed for the study area due to schedule and budget limitations. A synoptic survey of the study area was performed by FTN in September 2000, but only limited data were collected during that survey. Therefore, the model was calibrated to historical conditions when hydrologic and water quality data were available. The only historical period for which water quality data were collected for all 4 subsegments was the June through December 1998 period when LDEQ collected their assessment data. The LDEQ stations for the 4 subsegments in the study area are:

Station 0655 – Mermentau River at Lacassine Wildlife Refuge (subsegment 050402)
Station 0657 – Gulf Intracoastal Waterway SSW of Iowa (subsegment 050602)
Station 0659 – Grand Lake near Talen's Landing (subsegment 050701)
Station 0660 – Gulf Intracoastal Waterway at Mile 170 (subsegment 050702)

The water quality data for this period were retrieved from the LDEQ website. These data are listed in tabular form in Appendix C and the temperature and DO are plotted in Figures C.1 and

C.2 (also located in Appendix C). The two conditions that usually characterize critical periods for DO are high temperatures and low flows. High temperatures decrease DO saturation values and increase rates for oxygen demanding processes (BOD decay, nitrification, and sediment oxygen demand (SOD)). In most systems, low flows cause reaeration rates to be lower. The purpose of selecting a critical period for calibration is so that the model will be calibrated as accurately as possible for making projection simulations for critical conditions.

Based on the data in Appendix C, the calibration period was selected as August 23 to October 22, 1998 (Julian day 236 to 296). This period represented the most critical period for DO.

The calibration targets (i.e., the concentrations to which the model was calibrated) for each parameter for each LDEQ station were set to the average of the concentrations measured during the calibration period. Because there were no LDEQ data for Sledge Canal, the calibration targets for Sledge Canal were based on data from the FTN synoptic survey in September 2000.

3.3 Temperature Correction of Kinetics (Data Type 4)

The temperature correction factors used in the model were consistent with the Louisiana Technical Procedures Manual (the "LTP"; LDEQ 2000b). These correction factors were:

- Correction for BOD decay: 1.047 (value in LTP is same as model default)
- Correction for SOD: 1.065 (value in LTP is same as model default)
- Correction for reaeration: 1.024 (specified in Data Group 4)
- Correction for ammonia N decay: 1.070 (specified in Data Group 4)
- Correction for organic N decay: 1.020 (not specified in LTP; model default used)

3.4 Hydraulics and Dispersion (Data Types 9 and 10)

The hydraulics were specified in the input for the LA-QUAL model using the power functions (velocity = a * Q^b and depth = c * Q^d + e). Under low flow conditions, the water levels throughout the 4 subsegments being modeled are controlled by the operation of the five control structures discussed in Section 2. In other words, under low flow conditions, the depths and widths for each reach in the model can be assumed to be independent of flow rate. Therefore, the system was modeled with constant depth and width. This was specified in the model by setting the coefficients and exponents as follows (values for each reach are shown in Appendix D):

- velocity coefficient (a) = 1.0 / cross sectional area = 1.0 / (width * depth)
- velocity exponent (b) = 1.0
- depth coefficient (c) = depth
- depth exponent (d) = 0.0
- depth constant (e) = 0.0

Widths and depths were estimated primarily from topographic maps and information from the Corps of Engineers (see Appendix D).

Tidal dispersion was accounted for by specifying dispersion coefficients in data group 9 of the model input. The dispersion coefficient for each reach was set to 20.5 m^2/sec, which is the same value used in the Bayou Lacassine model (FTN, 2000a). This value is also consistent with the dispersion coefficient of 15 m^2/sec used by LDEQ at the lower end of the Mermentau River model (LDEQ 1999). The value of 20.5 m^2/sec was considered appropriate for all reaches in this model.

3.5 Initial Conditions (Data Type 11)

The primary parameter that is specified in the initial conditions for LA-QUAL is the temperature for each reach (because temperature was not being simulated). The temperature for each reach was set to the average of the measured values at the appropriate LDEQ station during the calibration period. The input data and sources are shown in Appendix D.

For constituents not being simulated, the initial concentrations were set to zero; otherwise, the model would have assumed a fixed concentration of those constituents and the model would have included the effects of the unmodeled constituents on the modeled constituents (e.g., the effects of algae on DO).

3.6 Water Quality Kinetics (Data Types 12 through 13)

Kinetic rates used in LA-QUAL include reaeration rates, (SOD), CBOD decay rates, nitrification rates, and mineralization rates (organic nitrogen decay). The values used in the model input are shown in Appendix D.

For reaeration, the surface transfer coefficient (K_L) was specified for each reach (option 20 in the model). Under low flow conditions, all of the reaches in this model have velocities so low that reaeration equations such as the Texas equation or the O'Connor Dobbins equation yield reaeration coefficients that are lower than the minimum values specified in the LTP (0.7 m/day divided by depth). Also, each of the reaches except for the Sledge Canal was considered wide enough that wind-aided reaeration might be significant. Therefore, a wind-aided surface transfer coefficient was calculated using the same methodology as used in the Mermentau River model (LDEQ 1999) and in the Lake Fausse Pointe/Dauterive Lake model (FTN, 2000b). Daily wind speeds from the Lake Charles airport were averaged over the calibration period, corrected to a height of 1 m, and then used to calculate a wind-aided surface transfer coefficient of 1.25 m/day. The value of 1.25 m/day was specified in the model for all reaches except the Sledge Canal. Because the Sledge Canal is relatively narrow (only about 40 ft wide), it was assumed that wind would not significantly increase reaeration in that reach. Therefore, the surface transfer coefficient for the Sledge Canal was kept at the LTP default value of 0.7 m/day. The reaeration being computed by the model for the Sledge Canal (using 0.7 m/day) was still higher than the reaeration that would be computed using the Texas equation or O'Connor Dobbins equation.

The CBOD decay rate was set to 0.07/day, which is the average of values used at the downstream end of the Bayou Lacassine model (0.05/day; FTN, 2000a) and at the downstream end of the Mermentau River model (0.09/day; LDEQ 1999). The value of 0.07/day is slightly lower than the default value of 0.10/day that LDEQ provided in its guidance for uncalibrated modeling of the Mermentau and Vermilion-Teche basins (LDEQ 2000c). However, the value of 0.07/day yielded a more realistic calibration than did the value of 0.10/day.

The SOD rates were developed through iteration in the calibration. The SOD rate for each reach was adjusted so that predicted DO concentrations were similar to the calibration target values.

Mineralization rates (organic nitrogen decay) in the model were set to 0.02/day for all reaches. This value was based on information in "Rates, Constants, and Kinetics Formulations in Surface Water Quality Modeling" (EPA 1985). Nitrification rates were set to 0.10/day for all reaches, which is consistent with guidance in the LTP based on stream depth. The combination of these rates is consistent with LDEQ's guidance for uncalibrated modeling of the Mermentau and Vermilion-Teche basins (LDEQ 2000c). The LDEQ guidance specified a default rate of 0.05/day for nitrogenous biochemical oxygen demand (NBOD) decay, which represents the combination of mineralization and nitrification.

One other input value was specified for characterizing the nitrification process. In the program constants section of the model input file (data type 3), the nitrification inhibition option was set to 1 instead of the default of option number 2. Option number 1 was also used in the model of Bayou Lacassine (FTN, 2000a), which is very similar to the system being simulated here. With the default option, the nitrification rate drops rapidly when the DO drops below 2 mg/L, which results in an unrealistic build up of ammonia nitrogen at low DO values such as in the Sledge Canal. Option number 1 provides nitrification inhibition that is similar to what is used in other water quality models such as QUAL2E and WASP (see Figure 3.5 in Bayou Lacassine report).

3.7 Nonpoint Source Loads (Data Type 19)

The nonpoint source (NPS) loads that are specified in the model can be most easily understood as resuspended load from the bottom sediments and are modeled as SOD, benthic ammonia source rates, CBOD loads, and organic nitrogen loads. The SOD (specified in data type 12), the benthic ammonia source rates (specified in data type 13), and the mass loads of organic nitrogen and CBODu (specified in data type 19) were all treated as calibration parameters; their values were adjusted until the model output was similar to the calibration target values. The values used as model input are shown in Appendix D.

3.8 Headwater and Tributary Flow Rates (Data Types 20 and 24)

The inflows from the Mermentau River and Bayou Lacassine were set to the averages of USGS daily flow data during the calibration period. The Mermentau River inflow (the headwater for Lake Arthur) was set to the average flow for the Mermentau River at Mermentau (USGS gage number 08012150) plus the average flow for Bayou Queue de Tortue at Riceville (USGS gage number 08012300). The inflow from Bayou Lacassine was based on data for Bayou Lacassine near Lake Arthur (USGS gage number 08012470). Daily data for the entire calibration period are listed in Appendix C and average values used as model input are shown in Appendix D.

The upstream flow in Sledge Canal was assumed to be zero based on field observations during the synoptic survey in September 2000.

For the Gulf Intracoastal Waterway (GIWW), water often flows into the study area from both sides (i.e., towards the Mermentau River) during low flow conditions because the water levels are often lower in the Mermentau basin than in the Gulf. For the calibration period, daily measurements of water surface elevations were obtained from the Corps of Engineers website for both the inland and seaward sides of the Calcasieu Lock and Leland Bowman Lock. For each lock, the difference in water surface elevation across the lock was computed for each day and averaged for the calibration period. For both locks, the water surface elevation data showed that the net flow during the calibration period was towards the Mermentau River.

The flow entering the study area through each lock was calculated based on the amount of water that would flow through the lock from each lockage (each time the lock was operated). Except when during passage of a vessel, these locks were assumed to be closed throughout the calibration period to control salinity intrusion (as discussed in Section 2.1). The flow from each lockage was calculated as the average difference in water surface elevation across the lock multiplied by the width and length of the lock chambers. The lock dimensions were obtained from the Mermentau Basin Master Water Control Plan (USACE, 1998). The number of lockages at each lock during the calibration was based on the annual average number of lockages at each lock (USACE, 1998).

It should be noted that the model assumes that all water flowing into Grand Lake (the downstream most element in the model) will flow out of Grand Lake through a natural outlet. However, the natural outlet for Grand Lake is into the Mermentau River through the Catfish Point control structure, which was assumed to be closed throughout the calibration period for control of salinity intrusion. Because the annual average number of lockages at Catfish Point is much smaller than on the GIWW, the flow through the Catfish Point control structure was assumed to be negligible during the calibration period. The total amount of inflow to Grand Lake was assumed to be similar to the sum of evaporation and outflow into White Lake and surrounding marshes. During the calibration period, the water surface elevation in Grand Lake was about a foot below the typical elevation of the surrounding marsh land, so it is likely that a considerable amount of water was being absorbed by the marshes around Grand Lake and White Lake (LDNR, 2001). It is also likely that the water surface elevations of Grand Lake and White Lake gradually increased a small amount during the calibration period.

3.9 Headwater and Tributary Water Quality (Data Types 21 and 25)

Concentrations of DO, CBODu, organic nitrogen, and ammonia nitrogen were specified in the model for each headwater and tributary inflow. The values used as model input are shown in Appendix D.

Where available, LDEQ ambient monitoring data were used to specify inflow water quality. At each of the LDEQ stations listed below, water quality measurements during the calibration period were averaged to use as model input for the corresponding inflows.

LDEQ Station	Inflow for which data were used
0654 (Mermentau River at Highway 14)	Lake Arthur headwater
0851 (GIWW west of Boone's Corner)	GIWW West headwater
0679 (GIWW east of Vermilion Cutoff)	GIWW East headwater
0098 (Bayou Lacassine at Highway 14)	Bayou Lacassine inflow into GIWW West

Because station 0851 is in the Calcasieu basin, it was sampled in 1999 but not in 1998. For this station only, data from August 23 through October 22, 1999 were averaged and assumed to be representative of concentrations during the calibration period.

The LDEQ ambient monitoring data included DO, TOC, and TKN, but not CBOD or ammonia nitrogen. Therefore, CBODu was estimated from TOC and ammonia nitrogen was estimated from TKN. Relationships between these parameters were developed using data from the FTN synoptic survey in September 2000 and data from LDEQ's long term BOD analyses during 2000. The median ratio of TOC to $CBOD_5$ from the FTN synoptic survey data was 6.0 and the median ratio of CBODu to $CBOD_5$ from the LDEQ long term BOD data was 4.5. Combining these ratios yielded the following relationship that was used to develop model inputs:

CBODu = 0.75 * TOC

Also, the median ratio of ammonia nitrogen to TKN from the FTN synoptic survey data was 0.17. This value was similar to the median ratio of ammonia nitrogen to TKN from the LDEQ data. The organic nitrogen was then determined as TKN minus ammonia nitrogen. This yielded the following relationships that were used to develop model inputs:

Ammonia nitrogen = 0.17 * TKN
Organic nitrogen = 0.83 * TKN

3.10 Point Source Inputs (Data Types 24 and 25)

Flows and CBODu concentrations for the Lake Arthur STP and for the Kaplan STP were based on averages of the values on their discharge monitoring reports (DMRs) for August through October 1998. The CBODu values used for model input were obtained by multiplying the BOD_5 values from the DMRs by an assumed CBODu:BOD_5 ratio of 2.3 (which is consistent with the LTP). The ammonia nitrogen concentration was also set to the average of DMR values for the

Lake Arthur STP, but ammonia nitrogen was not a reporting requirement on the Kaplan DMRs. For parameters not reported on the DMRs, concentrations were assumed based on typical wastewater values. The values used as model input are shown in Appendix D.

3.11 Lower Boundary Condition (Data Type 27)

Because longitudinal dispersion was explicitly specified in data type 9, the model required input values for downstream boundary conditions. As discussed previously, Grand Lake (the downstream end of the model) is cut off from the downstream portion of the Mermentau River and the Gulf by the Catfish Point control structure. Also, dispersion from White Lake into Grand Lake was assumed to be minimal because the connection between the two lakes is relatively narrow and most of the flow between the lakes during the calibration period should have been from Grand Lake into White Lake. Therefore, Grand Lake was assumed to have negligible dispersion with any downstream waterbody. Because the model still required input values for a downstream boundary, the average of the measured values for Grand Lake during the calibration period were used as the downstream boundary concentrations. The values used as model input are shown in Appendix D.

3.12 Model Results for Calibration

Plots of predicted and observed water quality for the calibration are presented in Appendix E and a printout of the LA-QUAL output file is included as Appendix F. The calibration was considered to be acceptable based on the amount of data that were available.

4.0 WATER QUALITY MODEL PROJECTION

EPA's regulations at 40 CFR 130.7 require the determination of TMDLs to take into account critical conditions for stream flow, loading, and water quality parameters. Therefore, the calibrated model was used to project water quality for critical conditions. The identification of critical conditions and the model input data used for critical conditions are discussed below.

4.1 Identification of Critical Conditions

Section 303(d) of the federal Clean Water Act and EPA's regulations at 40 CFR 130.7 both require the consideration of seasonal variation of conditions affecting the constituent of concern and the inclusion of an MOS in the development of a TMDL. For the TMDLs in this report, analyses of LDEQ long-term ambient data were used to determine critical seasonal conditions. A combination of implicit and explicit margins of safety was used in developing the projection model.

Critical conditions for DO have been determined for the Mermentau basin in previous TMDL studies. The analyses concluded that the critical conditions for stream DO concentrations occur during periods with negligible nonpoint runoff, low stream flow, and high stream temperature.

When the rainfall runoff (and nonpoint loading) and stream flow are high, turbulence is higher due to the higher flow and the stream temperature is lowered by the cooler precipitation and runoff. In addition, runoff coefficients are higher in cooler weather due to reduced evaporation and evapotranspiration, so that the high flow periods of the year tend to be the cooler periods. DO saturation values are, of course, much higher when water temperatures are cooler, but BOD decay rates are much lower. For these reasons, periods of high loading are periods of higher reaeration and DO but not necessarily periods of high BOD decay.

LDEQ interprets this phenomenon in its TMDL modeling by assuming that the annual nonpoint loading, rather than loading for any particular day, is responsible for the accumulated benthic blanket of the stream, which is, in turn, expressed as SOD and/or resuspended BOD in the model. This accumulated loading has its greatest impact on the stream during periods of higher temperature and lower flow.

According to the LTP, critical summer conditions in DO TMDL projection modeling are simulated by using the annual 7Q10 flow or 0.1 cfs, whichever is higher, for all headwaters, and 90th percentile temperature for the summer season. Model loading is from point sources, perennial tributaries, SOD, and resuspension of sediments. Again, model loading is from point sources, perennial tributaries, SOD, and resuspension of sediments. In addition, all point sources are assumed to be discharging at design capacity.

In reality, the highest temperatures occur in July and August, the lowest stream flows occur in October and November, and the maximum point source discharge occurs following a significant rainfall, i.e., high-flow conditions. The combination of these conditions plus the impact of other conservative assumptions regarding rates and loadings yields an implicit MOS that is not quantified. Over and above this implicit MOS, an explicit MOS of 20% for point sources and 10% for nonpoint sources was incorporated into the TMDLs in this report to account for future growth and model uncertainty.

4.2 Temperature Inputs

The LTP (LDEQ 2000b) specified that the critical temperature should be determined by calculating the 90th percentile seasonal temperature for the waterbody being modeled. Because none of the LDEQ stations in the study area has more than 6 months of data, LDEQ data from other subsegments were used for this analysis. In the Mermentau River TMDL (LDEQ 1999), long term temperature data from the Mermentau River at Mermentau (LDEQ station 0003) were used to calculate a 90th percentile summer temperature of 28.7ºC. However, the water temperatures for the Mermentau River station during June through December 1998 were slightly cooler than temperatures in the study area during that time. Therefore, the critical temperature for each subsegment in the study area was estimated as the 90th percentile summer temperature for the Mermentau River (28.7ºC) plus the average temperature difference during June – December 1998 between that subsegment and the Mermentau River station. These values were specified in data type 11 in the model input and are shown in Appendix G.

Because all 4 of the subsegments in the study area have a year round standard for DO, a winter projection simulation was not performed. As discussed above, the most critical time of year for meeting a constant DO standard is the period of high temperatures and low flows (i.e., summer).

4.3 Headwater and Tributary Inputs

The inputs for the headwaters and tributaries for the projection simulation were based on guidance in the LTP as well as output from projection models of upstream waterbodies (in previously completed TMDLs). According to the LTP, the critical flow rates for summer should be set to either the 7Q10 flow or 0.1 cfs, whichever is higher. Also, the LTP specifies that the DO concentration for headwater and tributary inflows should be set to 90% saturation at the critical temperature. The values used as model input in the projection simulation are shown in Appendix G.

The flows and concentrations for the Mermentau River (the headwater for Lake Arthur) were taken from the output at the downstream end of the model for the summer projection simulation in the Mermentau River TMDL (LDEQ 1999). The flows and concentrations for the Bayou Lacassine inflow into the GIWW West were taken from the output at the downstream end of the model for the summer projection simulation in the Bayou Lacassine TMDL (FTN, 2000a). Both of these TMDLs for the upstream waterbodies were consistent with the LTP and have been approved by EPA. It should be noted that the DO standard for both of these upstream waterbodies is 3 mg/L during summer (compared to 5 mg/L for the study area).

For Sledge Canal, the 7Q10 was assumed to be zero based on the small drainage area. Therefore, the headwater inflow rate for Sledge Canal was set to 0.1 cfs to be consistent with the LTP. The DO concentration for the Sledge Canal headwater was set to 90% saturation at the critical temperature (based on the LTP). Inflow concentrations for the other parameters (CBODu, organic nitrogen, and ammonia nitrogen) were set to averages of values measured during the calibration period at the LDEQ station in the GIWW East subsegment (station 0660). This was done because the are no observed data for the Sledge Canal upstream of the City of Kaplan STP (the FTN synoptic survey data were taken downstream of the STP).

The critical flows into the GIWW subsegments were assumed to be similar to the inflow rates used for the calibration. These inflow rates were small (less than 10 cfs). As discussed in Section 2.1, the water levels during low flow conditions are frequently lower on the inland sides of these locks than on the seaward sides. Therefore, setting the inflow to the GIWW subsegments to a value greater than zero during critical conditions seemed reasonable. The water quality concentrations used for these inflows in the calibration were assumed to be representative of critical conditions and were therefore used for the projection also.

4.4 Point Source Inputs

The model inputs for the Town of Lake Arthur STP were taken from the output at the downstream end of the model for the summer projection simulation in the TMDL for the Lake Arthur STP (USL 1997). In that TMDL, the model simulated an unnamed canal from the STP discharge to the edge of Lake Arthur (about 1 mile). The procedures used in the TMDL for the Lake Arthur STP were consistent with guidance in the LTP. This included incorporation of an explicit 20% margin of safety by setting the STP flow in the model to 125% of the design flow.

For the Kaplan STP, the flow was set to 125% of the design flow in order to incorporate an explicit 20% margin of safety. Because the initial projection simulation was showing low DO values in Sledge Canal, the concentrations for the Kaplan STP discharge were set assuming an upgrade in the level of treatment. The current permit limits include a monthly average BOD_5 concentration of 30 mg/L. It was assumed here that the treatment would be upgraded to meet a BOD_5 concentration of 10 mg/L, an ammonia nitrogen concentration of 2 mg/L, and an effluent DO concentration of 5 mg/L. These values are consistent with the limits for the Lake Arthur STP. The values used as model input in the projection simulation are shown in Appendix G.

4.5 Nonpoint Source Loads

Because the initial projection simulation was showing low DO values in all of the reaches, the nonpoint source (NPS) loadings were reduced until all of the predicted DO values were equal to or greater than the water quality standard of 5.0 mg/L. Within each reach, the same percent reduction was applied to all components of the nonpoint source loads (SOD and mass loads of CBODu and ammonia nitrogen). The values used as model input in the projection simulation are shown in Appendix G.

4.6 Downstream Boundary

For the projection simulation, the downstream boundary condition for temperature was set to the same as the critical temperature for Grand Lake. This was done so that the model would not change the temperature that was specified for Grand Lake. For DO, the downstream boundary condition was set to the water quality standard (5.0 mg/L) so that the model would not simulate an artificial DO sink due to dispersion with the downstream boundary. The values used as model input in the projection simulation are shown in Appendix G.

4.7 Other Inputs

The only model inputs that were changed from the calibration to the projection simulation were the inputs discussed above in Sections 4.2 through 4.6. All of the other model inputs (e.g., hydraulic and dispersion coefficients, decay rates, reaeration rates, etc.) were unchanged from the calibration simulation.

4.8 Model Results for Projection

Plots of predicted water quality for the projection are presented in Appendix H and a printout of the LA-QUAL output file is included as Appendix I.

For all reaches except the Sledge Canal, NPS load reductions of 40% – 50% were required to bring the predicted DO values to at least 5.0 mg/L. Reductions of the NPS loads were necessary because the loads from the Lake Arthur STP had little effect on the predicted DO values in Lake Arthur and virtually no effect on the predicted DO in other reaches.

For the Sledge Canal, a NPS load reduction of 99% was required to bring the predicted DO values to at least 5.0 mg/L. This extreme reduction was required even after reducing the Kaplan STP's discharge from 30 mg/L $CBOD_5$ (secondary treatment) to 10 mg/L $CBOD_5$ and 2 mg/L ammonia nitrogen (advanced treatment). If the Kaplan STP discharge was reduced further to 5 mg/L $CBOD_5$ and 1 mg/L ammonia nitrogen, the NPS load reduction required to meet the DO standard would still be over 90%. Based on these results, it will be very difficult to meet a DO standard of 5 mg/L in the Sledge Canal.

The percentage reductions for NPS loads mentioned above represent percentages of the entire NPS loading, not percentages of the manmade NPS loading. The NPS loads in this report were not divided between natural and manmade because it would be difficult to estimate natural NPS loads for the waterbodies in the study area. There are no LDEQ reference streams in the lower Mermentau basin and the waterbodies in the study area are much different than reference streams in other parts of the state. In previous TMDLs on nearby waterbodies, the percentage of total NPS loading that was estimated to be manmade varied from 36% for Bayou Lacassine (FTN, 2000a) to 73% for the Mermentau River upstream of Lake Arthur (LDEQ 1999).

5.0 TMDL CALCULATIONS

5.1 DO TMDLs

A total maximum daily load (TMDL) for DO has been calculated for each subsegment in the study area based on the results of the projection simulation. The DO TMDLs are presented as oxygen demand from CBODu, NBOD (decay of organic nitrogen and ammonia nitrogen), and SOD. Summaries of the loads for each subsegment are presented in Tables 5.1 – 5.4.

The NBOD loads were calculated as 4.33 times the sum of organic nitrogen and ammonia nitrogen (assuming that all organic nitrogen is eventually converted to ammonia). The value of 4.33 is the same ratio of oxygen demand to nitrogen that is used by the LA-QUAL model. For the SOD loads, a temperature correction factor was included in the calculations (in order to be consistent with LDEQ procedures).

The wasteload allocations (WLAs) for minor point sources represent the loads from small oxygen demanding discharges that were not explicitly modeled. In general, these WLAs were based on current permit limits with no reductions. For discharges with no available flow information, a design flow of 0.001 MGD was assumed. For discharges with no permit limits for ammonia nitrogen, effluent concentrations for ammonia nitrogen were assumed based on the BOD_5 permit limits and typical combinations of BOD_5 and ammonia nitrogen listed in the LTP (LDEQ 2000b). For discharges that have permit limits for COD but not BOD_5, the COD values were assumed to be similar to ultimate BOD.

Because the WLAs for minor point sources represented loads that were not simulated in the model, these loads were added to the total loads simulated in the model. The load allocations (LAs) for nonpoint sources were calculated as 90% of the NPS load simulated in the model. The other 10% of the NPS load simulated in the model was designated as an explicit MOS for nonpoint sources. The explicit MOS for point sources was set to 20% of the total point source loading.

Table 5.1. DO TMDL for Subsegment 050402 (Lake Arthur).

	Oxygen demand (kg/day) from:				Total oxygen demand (kg/day)
	CBODu	**Organic Nitrogen**	**Ammonia Nitrogen**	**SOD**	
WLA for Lake Arthur STP	63.59	210.70	8.98	n.a.	283.27
WLA for minor point sources	65.47	492.72	246.36	n.a.	804.55
MOS for all point sources	32.26	175.86	63.83	n.a.	271.96
LA for nonpoint sources	1538.08	575.85	115.17	221.36	2450.45
MOS for nonpoint sources	170.90	63.98	12.80	24.60	272.27
Total maximum daily load	1870.30	1519.11	447.14	245.96	4082.50

Table 5.2. DO TMDL for Subsegment 050602 (GIWW West).

	Oxygen demand (kg/day) from:				Total oxygen demand (kg/day)
	CBODu	**Organic Nitrogen**	**Ammonia Nitrogen**	**SOD**	
WLA for minor point sources	0.78	5.90	2.95	n.a.	9.63
MOS for minor point sources	0.20	1.48	0.74	n.a.	2.41
LA for nonpoint sources	1267.13	134.90	5.86	88.66	1496.55
MOS for nonpoint sources	140.79	15.00	0.65	9.85	166.28
Total maximum daily load	1408.90	157.28	10.20	98.51	1674.87

Table 5.3. DO TMDL for Subsegment 050701 (Grand Lake).

	Oxygen demand (kg/day) from:				Total oxygen demand (kg/day)
	CBODu	**Organic Nitrogen**	**Ammonia Nitrogen**	**SOD**	
WLA for minor point sources	0.20	1.48	0.74	n.a.	2.42
MOS for minor point sources	0.05	0.37	0.18	n.a.	0.60
LA for nonpoint sources	1800.00	0.00	0.00	29.48	1829.48
MOS for nonpoint sources	200.00	0.00	0.00	3.28	203.28
Total maximum daily load	2000.25	1.85	0.92	32.76	2035.78

Table 5.4. DO TMDL for Subsegment 050702 (GIWW East and Sledge Canal).

	Oxygen demand (kg/day) from:				Total oxygen demand (kg/day)
	CBODu	Organic Nitrogen	Ammonia Nitrogen	SOD	
WLA for City of Kaplan STP	95.39	134.68	35.91	n.a.	265.98
WLA for minor point sources	290.34	2186.35	1093.17	n.a.	3569.86
MOS for all point sources	96.43	580.26	282.23	n.a.	958.96
LA for nonpoint sources	2850.66	322.86	17.98	239.59	3431.08
MOS for nonpoint sources	316.74	35.87	2.00	26.62	381.23
Total maximum daily load	3649.56	3260.02	1431.29	266.21	8607.11

5.2 Nutrient TMDLs

Because 3 of the 4 subsegments in the study area were on the 303(d) list for nutrients as well as DO (see Table 1.1), nutrient TMDLs were also developed. As discussed in Section 2.2, Louisiana has no numeric standards for nutrients, but has a narrative standard that states that “the naturally occurring range of nitrogen-phosphorus ratios shall be maintained” (LDEQ 2000a). For these TMDLs, nutrients were defined as total inorganic nitrogen (ammonia nitrogen plus nitrate/nitrite nitrogen) and total phosphorus. The value used for the naturally occurring nitrogen to phosphorus ratio was 1.96, which was the median ratio of total inorganic nitrogen to total phosphorus from historical data that was analyzed for a previous nutrient TMDL for the Lake Fausse Pointe/Dauterive Lake system (FTN 2000b).

The first step in calculating the nutrient TMDLs was to determine the loads of total inorganic nitrogen (TIN) that were simulated in the projection model. The loads in the projection model represent the maximum allowable loads that will maintain DO standards. Then the allowable loads of total phosphorus (TP) were calculated by dividing the nitrogen loads by the naturally occurring ratio of TIN to TP (which was 1.96 as discussed above). The resulting loads of TIN and TP for each subsegment are presented in Tables 5.5 through 5.8.

Table 5.5. Nutrient TMDL for Subsegment 050402 (Lake Arthur).

	Ammonia Nitrogen	**NO_2+NO_3 Nitrogen**	**Total Phosphorus (kg/day)**
WLA for Lake Arthur STP	2.07	3.54	2.86
WLA for minor point sources	56.90	28.44	43.54
MOS for all point sources	14.74	7.99	11.60
LA for nonpoint sources	26.60	10.34	18.85
MOS for nonpoint sources	2.95	1.15	2.09
Total Maximum Daily Load	103.26	51.46	78.94

Table 5.6. Nutrient TMDL for Subsegment 050602 (GIWW West).

	Ammonia Nitrogen	**NO_2+NO_3 Nitrogen**	**Total Phosphorus (kg/day)**
WLA for minor point sources	0.68	0.08	0.39
MOS for all point sources	0.17	0.02	0.10
LA for nonpoint sources	1.35	0.51	0.95
MOS for nonpoint sources	0.15	0.06	0.04
Total Maximum Daily Load	2.35	0.67	1.48

Table 5.7. Nutrient TMDL for Subsegment 050701 (Grand Lake).

	Ammonia Nitrogen	**NO_2+NO_3 Nitrogen**	**Total Phosphorus (kg/day)**
WLA for minor point sources	0.17	0.02	0.10
MOS for all point sources	0.04	0.00	0.02
LA for other nonpoint sources	0.00	0.00	0.00
MOS for all nonpoint sources	0.00	0.00	0.00
Total Maximum Daily Load	0.21	0.02	0.12

Table 5.8. Nutrient TMDL for Subsegment 050702 (GIWW East and Sledge Canal).

	Ammonia Nitrogen	**NO_2+NO_3 Nitrogen**	**Total Phosphorus (kg/day)**
WLA for City of Kaplan STP	8.29	.29	4.38
WLA for minor point sources	252.47	42.29	150.39
MOS for all point sources	65.19	10.65	38.69
LA for other nonpoint sources	4.15	2.91	3.60
MOS for all nonpoint sources	0.46	0.32	0.40
Total Maximum Daily Load	330.56	56.46	197.46

5.3 Ammonia TMDLs

Because one of the subsegments in the study area was on the 303(d) list for ammonia as well as DO (see Table 1.1), ammonia TMDLs were also developed. As discussed in Section 2.2, Louisiana has no numeric or narrative standards for ammonia. The impacts of ammonia on DO have been addressed through the DO TMDLs presented above. Another potential impact that ammonia can have is toxicity to aquatic life. Therefore, the predicted instream ammonia concentrations from the projection model were checked to make sure that they did not exceed EPA's published ammonia criteria for toxicity (EPA 1999).

The ammonia criteria for toxicity were calculated based on pH and water temperature using an equation that yields chronic criterion concentration (CCC) values with fish early life stages present (EPA 1999; page 83). The pH used for each reach was the average pH from LDEQ's ambient monitoring data during the calibration period. The temperature used for each reach was the same as the critical temperature in the projection model. As shown in Table 5.9, all of the predicted ammonia nitrogen concentrations were below the applicable CCC values. Therefore, the ammonia nitrogen loads that are included in the DO TMDLs above are appropriate for preventing ammonia toxicity as well as maintaining DO standards in the waterbodies.

Table 5.9. Comparison of CCC and predicted ammonia nitrogen concentrations.

Reach	pH (su)	Water Temperature (^oC)	Ammonia CCC (mg N/L)	Max. Predicted Ammonia Conc. in Reach (mg N/L)	Below CCC?
Lake Arthur - Upper	7.3	31.1	1.7	0.1	Yes
Lake Arthur - Lower	7.3	31.1	1.7	0.1	Yes
GIWW - West of Lake Arthur	7.3	31.3	1.7	0.1	Yes
GIWW – Leland Bowman to Sledge C.	7.1	31.9	1.8	0.1	Yes
Sledge Canal	7.1	31.9	1.8	1.3	Yes
GIWW – Sledge Canal to Lake Arthur	7.1	31.9	1.8	0.1	Yes
Grand Lake	7.5	31.4	1.5	0.1	Yes

5.4 Summary of NPS Reductions and Point Source Upgrades

In summary, the projection modeling used to develop the TMDLs above showed that nonpoint source (NPS) loads need to be reduced as follows to maintain the DO standard:

40% – Subsegment 050402 (Lake Arthur)
50% – Subsegment 050602 (GIWW West)
40% – Subsegment 050701 (Grand Lake)
50% – Subsegment 050702 (GIWW East, including Sledge Canal)

The required NPS reduction listed above for Subsegment 050702 is the average for the entire subsegment. In the Sledge Canal, the required reduction was 99%; however, the loading in Sledge Canal represented a small portion of the total loading for the entire subsegment.

The projection model also showed that a treatment upgrade would be required for the City of Kaplan STP. The effluent concentrations assumed for the two point sources that were modeled explicitly were:

Lake Arthur STP: 10 mg/L $CBOD_5$, 2 mg/L ammonia N, 5 mg/L DO (existing limits)
City of Kaplan STP: 10 mg/L $CBOD_5$, 2 mg/L ammonia N, 5 mg/L DO (upgrade)

5.5 Seasonal Variation

As discussed in Section 4.1, critical conditions for DO in Louisiana waterbodies have been determined to be when there is negligible nonpoint runoff and low stream flow combined with high water temperatures. In addition, the models account for loadings that occur at higher flows by modeling sediment oxygen demand. Oxygen demanding pollutants that enter the waterbodies during higher flows settle to the bottom and then exert the greatest oxygen demand during the high temperature seasons.

5.6 Margin of Safety

The MOS accounts for any lack of knowledge or uncertainty concerning the relationship between load allocations and water quality. As discussed in Section 4.1, the highest temperatures occur in July and August, the lowest stream flows occur in October and November, and the maximum point source discharge occurs following a significant rainfall, i.e., high-flow conditions. The combination of these conditions, in addition to other conservative assumptions regarding rates and loadings, yields an implicit MOS that is not quantified. In addition to the implicit MOS, the TMDLs in this report included explicit margins of safety of 20% for point source loads and 10% for nonpoint source loads.

6.0 SENSITIVITY ANALYSES

All modeling studies necessarily involve uncertainty and some degree of approximation. It is therefore of value to consider the sensitivity of the model output to changes in model coefficients, and in the hypothesized relationships among the parameters of the model. The sensitivity analyses were performed by allowing the LA-QUAL model to vary one input parameter at a time while holding all other parameters to their original value. The projection simulation was used as the baseline for the sensitivity analysis. The percent change of the model's minimum DO projections to each parameter is presented in Table 6.1. Each parameter was varied by $\pm$30%, except for temperature, which was varied $\pm$2ºC.

Values reported in Table 6.1 are sorted by percentage variation of minimum DO from smallest percentage variation to largest. Reaeration was the parameter to which DO is most sensitive (10% to 15%). The other parameters causing the greatest variations in the minimum DO values were velocity (9% to 14%) and depth (10% to 11%). The model results were slightly sensitive to wasteload flow and concentration, temperature, and SOD with variations in predicted DO ranging from 1% to 10%. The model was not sensitive to headwater flow or dispersion.

Table 6.1. Summary of results of sensitivity analyses.

Input Parameter	Parameter Change	Predicted minimum DO (mg/L)	Percent Change in Predicted DO (%)
Baseline	-	5.10	N/A
Dispersion	-30%	5.10	< 1%
Dispersion	+30%	5.10	< 1%
Headwater flow	-30%	5.09	< 1%
Headwater flow	+30%	5.11	< 1%
SOD	+30%	5.07	1%
SOD	-30%	5.14	1%
Organic N decay rate	+30%	5.03	1%
Organic N decay rate	-30%	5.18	2%
NH3 decay rate	+30%	5.01	2%
Waste Load Organic N	+30%	5.01	2%
Waste Load Organic N	-30%	5.20	2%
NH3 decay rate	-30%	5.23	3%
Waste Load NH3	+30%	4.96	3%
Waste Load NH3	-30%	5.24	3%
BOD decay rate	+30%	4.95	3%
Waste Load DO	-30%	4.91	4%
BOD decay rate	-30%	5.29	4%
Waste Load DO	+30%	5.30	4%
Velocity	+30%	4.89	4%
Waste Load flow	+30%	4.88	4%
Water Temperature	+2ºC	4.85	5%
Water Temperature	-2ºC	5.37	5%
Waste Load BOD	+30%	4.82	5%
Waste Load BOD	-30%	5.39	6%
Waste Load flow	-30%	5.43	6%
Reaeration	+30%	5.54	9%
Depth	+30%	4.61	10%
Depth	-30%	5.64	11%
Velocity	-30%	5.82	14%
Reaeration	-30%	4.36	15%

7.0 OTHER RELEVANT INFORMATION

This TMDL has been developed to be consistent with the antidegradation policy in the LDEQ water quality standards (LAC 33:IX.1109.A).

Although not required by this TMDL, LDEQ utilizes funds under Section 106 of the federal Clean Water Act and under the authority of the Louisiana Environmental Quality Act to operate an established program for monitoring the quality of the state's surface waters. The LDEQ Surveillance Section collects surface water samples at various locations, utilizing appropriate sampling methods and procedures for ensuring the quality of the data collected. The objectives of the surface water monitoring program are to determine the quality of the state's surface waters, to develop a long-term data base for water quality trend analysis, and to monitor the effectiveness of pollution controls. The data obtained through the surface water monitoring program is used to develop the state's biennial 305(b) report (Water Quality Inventory) and the 303(d) list of impaired waters. This information is also utilized in establishing priorities for the LDEQ nonpoint source program.

The LDEQ has implemented a watershed approach to surface water quality monitoring. Through this approach, the entire state is sampled over a five-year cycle with two targeted basins sampled each year. Long-term trend monitoring sites at various locations on the larger rivers and Lake Pontchartrain are sampled throughout the five-year cycle. Sampling is conducted on a monthly basis or more frequently if necessary to yield at least 12 samples per site each year. Sampling sites are located where they are considered to be representative of the waterbody. Under the current monitoring schedule, targeted basins follow the TMDL priorities. In this manner, the first TMDLs will have been implemented by the time the first priority basins will be monitored again in the second five-year cycle. This will allow the LDEQ to determine whether there has been any improvement in water quality following establishment of the TMDLs. As the monitoring results are evaluated at the end of each year, waterbodies may be added to or removed from the 303(d) list. The sampling schedule for the first five-year cycle is shown below. The Mermentau River Basin will be sampled again in 2003.

1998 – Mermentau and Vermilion-Teche River Basins
1999 – Calcasieu and Ouachita River Basins
2000 – Barataria and Terrebonne Basins
2001 – Lake Pontchartrain Basin and Pearl River Basin
2002 – Red and Sabine River Basins

(Atchafalaya and Mississippi Rivers will be sampled continuously.)

In addition to ambient water quality sampling in the priority basins, the LDEQ has increased compliance monitoring in those basins, following the same schedule. Approximately 1,000 to 1,100 permitted facilities in the priority basins were targeted for inspections. The goal set by LDEQ was to inspect all of those facilities on the list and to sample 1/3 of the minors and 1/3 of the majors. During 1998, 476 compliance evaluation inspections and 165 compliance sampling inspections were conducted throughout the Mermentau and Vermilion-Teche River Basins.

8.0 PUBLIC PARTICIPATION

When EPA establishes a TMDL, 40 CFR 130.7(d)(2) requires EPA to publicly notice and seek comment concerning the TMDL. This TMDL was prepared under contract to EPA. After internal review of this TMDL, EPA will commence preparation of a notice seeking comments, information, and data from the general and affected public. If comments, data, or information are submitted during the public comment period, then this TMDL may be revised accordingly. After considering public comment, information, and data, and making any appropriate revisions, EPA will transmit the revised TMDL to the Louisiana Department of Environmental Quality (LDEQ) for incorporation into LDEQ's current water quality management plan.

9.0 REFERENCES

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APPENDICES A THROUGH I ARE AVAILABLE FROM EPA UPON REQUEST

APPENDIX J

Responses to Comments

COMMENTS AND RESPONSES
LAKE ARTHUR, GRAND LAKE, AND GULF INTRACOASTAL WATERWAY
TMDLs FOR DO, NUTRIENTS, AND AMMONIA
April 19, 2002

EPA appreciates all comments concerning these TMDLs. Comments that were received are shown below with EPA responses inserted in a different font.

GENERAL COMMENTS FROM LOUISIANA DEPARTMENT OF ENVIRONMENTAL QUALITY (LDEQ) (some of these comments may not apply to this report):

In view of LDEQ's TMDL development schedule and the rapidly approaching deadline, LDEQ has made a limited review of the TMDLs published by EPA on October 15, 2001. LDEQ expects to make a more detailed review on at least some of these TMDLs after the first of the year. In the future, LDEQ requests that EPA provide hard copies of the TMDLs and Appendices for LDEQ review. Several electronic files required software which is not used by LDEQ thus making it impossible to review some portions of several TMDLs. Hard copies will insure that the complete official document is being reviewed and will eliminate the time required for LDEQ to try to put together the document from electronic files. In general, LDEQ found these TMDLs to be unacceptable, based on inadequate data and not implementable.

Federal Register Notice: Volume 66, Number 199, pages 52403 - 52404 (10/15/2001)

A. Vermilion River Cutoff DO and Nutrients .pdf
B. Bayou Chene DO .pdf
C. Bayou du Portage DO .pdf
D. Bayou Mallet DO, Nutrients and Ammonia .pdf
E. Bayou Petite Anse DO and Nutrients .pdf
F. Bayou Tigre DO and Nutrients .pdf
G. Big Constance Lake and Mermentau Coastal Bays and Gulf Water TMDLs for DO and Nutrients .pdf
H. Charenton Drainage and Navigation Canal and West Cote Blanche Bay TMDLs for DO and Nutrients.pdf
I. Chatlin Lake Canal/Bayou Du Lac and Bayou Des Glaises Diversion Channel TMDLs for DO and Nutrients.pdf
J. Dugas Canal DO and Nutrients .pdf
K. Franklin Canal DO and Nutrients .pdf
L. Freshwater Bayou Canal DO and Nutrients .pdf
M. Irish Ditch/Big Bayou DO .pdf

N. Lake Arthur, Grand Lake, and Gulf Intracoastal Waterway TMDLs for DO, Nutrients, and Ammonia .pdf
O. Lake Peigneur DO and Nutrients .pdf
P. New Iberia Southern Drainage Canal DO and Nutrients .pdf
Q. Spanish Lake DO .pdf
R. Tete Bayou DO and Nutrients .pdf
S. Bayou Carron DO and Nutrients .pdf
T. West Atchafalaya Basin Protection Levee Borrow Pit Canal DO.pdf

1. Many of these TMDLs are based on models using historical water quality data gathered at a single location rather than survey data gathered at several sites spaced throughout the waterbody. Hydraulic information used was generally not taken at the same time as the water quality data used. The availability of only one water quality data site is not sufficient justification to simulate the subsegment using a one reach, one element model. Additional reaches and elements must be used to represent the subsegment and additional data must be obtained in order for these TMDLs to be valid. The recommended maximum limits cited in the LAQUAL User's Manual for element width and length have been grossly exceeded in many of the models. The spreadsheet calibration and projection graphs that were provided do not match the plots produced by the LA-QUAL model. Please explain why they do not match. The LAQUAL graphics for a few elements produces a graph that does not represent the model output. It's an anomaly of the graphics routine. The calibrations are inadequate due to the lack of a hydrologic calibration and the paucity of water quality data. The resulting TMDLs are invalid. LDEQ does not accept these TMDLs.

Response: The TMDLs were based on existing data plus information that could be obtained with available resources. Each model was developed using the most appropriate hydraulic information and water quality data that were available. The level of detail at which each subsegment was modeled was consistent with the amount of available data. Although having only one element in a model causes inaccuracies in the LAQUAL graphics, having only one element in a model does NOT cause errors in the tabular output (which is what the graphs in the reports are based on). Although LDEQ typically collects more data for model calibration than what was available for calibration of these models, EPA considers these model calibrations and the resulting TMDLs to be valid.

2. LDEQ does not consider any of these waters to be impaired due to nutrients or ammonia. LDEQ does not consider Vermilion River Cutoff (060803), Mermentau Coastal Bays and Gulf Water (050901), Charenton Drainage and Navigation Canal (060601), West Cote Blanche Bay (061001), Bayou Des Glaises Diversion channel (060207), Grand Lake (070701), Gulf Intracoastal Waterway (050702, Lake Peigneur (060909), New Iberia Southern Drainage Canal (060904) and West Atchafalaya Basin Protection Levee Borrow Pit Canal to be impaired by biochemical oxygen-demanding substances. Many of these waters simply have inappropriate

standards and criteria. The resources spent on developing these TMDLs could have been far more effectively and wisely spent on reviewing, approving, and assisting in the development of appropriate standards and criteria for these waters through the UAA process.

Response: TMDLs were developed for these subsegments based on the requirements of Section 303(d) of the Clean Water Act and regulations at 40 CFR 130.7 and the suspected causes of impairment (organic enrichment/low DO, nutrients, or ammonia) for each subsegment in the EPA Modified Court Ordered 303(d) List.

3. Remove the reference and all references to the unpublished LDEQ document, "Defaults for Uncalibrated Modeling". This is not an acceptable reference and any defaults selected on this basis must be reevaluated and based on acceptable references. Some of the models must be redone because of inappropriately selected defaults. At this time, LDEQ has no plans to revise, complete or publish this document.

Response: The unpublished LDEQ document that is mentioned here was provided to EPA's contractor without any instructions not to use it. The model coefficients listed in that document appear to be reasonable and consistent with values used in other modeling studies in southern Louisiana.

4. The percent reduction of the nonpoint source load must not be reported as an overall average of the individual percent reduction applied to each reach. This approach does not insure that standards will be met in all reaches and will be difficult to implement. In consideration of future implementation plans, LDEQ does not vary the percent reduction required from reach to reach. LDEQ uses a uniform percent reduction within a watershed unless there are unique conditions, such as a general change in landuse, that dictate a further breakdown. These unique conditions must be adequately documented in the report in order to facilitate future implementation plans. Specifying type of land use is helpful in defining nonpoint loading. LDEQ requests a calculation sheet of the NPS reduction percentages and asks that language be added to the report describing the calculation process.

Response: EPA appreciates this comment but believes that an average percent reduction is acceptable. EPA will consider this in future development of TMDLs in Louisiana.

In the lower Mermentau and Vermilion River Basins, much of the nonpoint loading affecting some of these subsegments and adding to their benthic blanket is coming from the tributaries feeding them. Many of the headwater tributaries have recent TMDL's that require dramatic percentage reductions to the nonpoint contributions. By implementing the reductions to nonpoint loads upstream, the current problems in these lower subsegments will be reduced.

Response: EPA recognizes that TMDLs have been developed upstream of several of these subsegments. Implementing upstream reductions in nonpoint loads should require much less reduction of loadings from within these subsegments. The required percent reductions for these subsegments were not intended to be in addition to upstream reductions.

5. The percentage reductions listed were not calculated based on the written procedure described in several TMDLs. These values did not take the MOS into consideration. It is also LDEQ's policy to make a no-man-made load projection run which will estimate the natural background loads. The contractor should include a no-man-made load projection run in each TMDL report.

Response: The percent reductions were calculated by subtracting the projection input value from the calibration input value and then dividing by the calibration input value. This procedure is slightly different than what LDEQ uses but still provides percent reductions that are useful.

6. CBODu and NH3-N were estimated from surrogate parameters rather than actual measured data for most of the TMDLs. Based on the measured data from the last two years of LDEQ water quality surveys, LDEQ objects to the correlation of TOC to CBOD and NH3-N to TKN, unless these correlations are taken from water quality data on the modeled waterbody. Our studies have shown only a moderate correlation between these two parameters within the same waterbody, however when this correlation was attempted across waterbodies extreme variability was seen and the correlation was not judged valid. It is possible that a combination of surrogates will obtain a better correlation, such as TOC along with color, turbidity, pH, etc. LDEQ is currently researching these options.

Response: EPA agrees that it would be ideal to have data collected from the modeled waterbody for relating TOC to CBOD and NH3-N to TKN. However, for these subsegments, there was insufficient data from which these relationships could be developed.

7. LDEQ takes exception to the equating of COD to CBODu in some of the TMDLs. There is no data to support this assumption. No direct correlation has been drawn between these two parameters. The only correlations that have been found are variable and dependant on the type of discharge. LDEQ requests that facilities with only COD limits be removed from the WLA load calculations.

Response: EPA agrees that COD is not an ideal indicator of CBODu. However, EPA believes that most effluents that exert significant COD are likely to exert some oxygen demand in natural waterbodies and therefore the discharges with COD limits should be included in the TMDLs.

8. CBODU and Org-N settling rates were not used. This is not justifiable in areas dominated by agricultural activities and is poor practice for TMDLs on Louisiana waters. The models must be revised to include settling rates.

Response: Without the use of settling rates, all of the pollutant loading remains in the water column where it can consume oxygen. Depending on the model settings for conversion of settled pollutant loading to SOD, the model can be more conservative without settling rates. Other applications of water quality models for TMDLs on southern Louisiana waterbodies have not used settling rates and have been approved by LDEQ.

9. The TMDLs should be for biochemical oxygen-demanding substances instead of DO. DO is an indicator of the impact of biochemical oxygen demanding load, hydrologic modifications, excessive algae blooms, etc.

Response: The TMDLs in Section 5 of each report are already expressed in terms of oxygen demand.

10. Nitrification inhibition option number 2 is valid for Louisiana's waterbodies. Various studies have shown that Louisiana does not have a buildup of NH3-N in its waterbodies. If option 1 was needed for a proper calibration then that should be stated as such.

Response: The nitrification inhibition option was set based on algorithms in other widely used water quality models. Option 1 has been used in other water quality modeling applications for TMDLs on southern Louisiana waterbodies that have been approved by LDEQ.

11. A winter projection model was not developed for most of the TMDLs. Winter projection models must be developed to address seasonality requirements of the Clean Water Act. Where point sources have seasonally variable effluent limitations or such seasonal variations are proposed, a winter projection model is required to show that standards are met year-round.

Response: As discussed in Section 4.2 of each report, summer is the most critical season for meeting the year round standard for DO for this subsegment. Therefore, the summer simulation satisfies the seasonality requirements of the Clean Water Act. Performing additional simulations to evaluate permit limits that are seasonal or hydrograph controlled releases was not required for developing these TMDLs and can be done by LDEQ or by permittees.

12. There was no documentation (LA-QUAL plots) to indicate that the model was calibrated to all hydrologic parameters (i.e. flow, width, depth, time of travel, velocity, chloride balance, etc.). Apparently flow balances were performed, however a flow balance is not a hydrologic calibration. Most of the models must be recalibrated with adequate hydrologic data. Calibration plots for all of the hydrologic parameters must be provided in the appendices.

Response: The values of depth, width, and flow in each model were estimated based upon the most appropriate available information. Hydraulic calibration of each model was not possible due to a lack of data.

13. The calibration and projection plots for dissolved oxygen must be provided in the body of the reports. Additional projection plots for CBODU, NH3-N, and Org-N must be provided in the appendices.

Response: The placement and number of plots in the draft reports are acceptable.

14. The calibration simulation must be used as the baseline for the sensitivity analysis, not the projection simulation. LDEQ requests that all TMDLs be revised in this regard.

Response: The sensitivity analysis can be developed using either the calibration or the projection as a baseline. EPA will consider this in future development of TMDLs in Louisiana.

15. A list of all point source dischargers must be provided in the body of the reports. Only dischargers with flows that reach the named waterbody should be included in the TMDLs.

In several TMDLs, a default 0.001 MGD flow rate was assigned to dischargers where a flow rate was not available. This practice is unacceptable to LDEQ. This default flow rate is extremely low (LDEQ would typically use 0.005 MGD as a minimum) and could strictly limit these dischargers' allowable permit loads when their permits are renewed. Additional research should be done to determine the facility type and anticipated flow rates of these facilities.

Response: The placement of the list of point source dischargers in the draft reports is acceptable. The dischargers with no flow rate information are believed to have very small flow rates representing a very small portion of the total TMDLs. The actual flow rate for each facility can be determined by LDEQ when the facility's permit is being renewed.

16. LDEQ does not agree with the minor point sources loads being subtracted from the NPS load as was done in several of the TMDLs. The pollutant loads being addressed are non-conservative loads. Many of these dischargers are located on small tributaries to the 303(d) waterbody which have recovered prior to entering into that system. Thus they are not contributing to the pollutant loads in the impaired waterbody. LDEQ's current procedure is to add these loads to the WLA portion of the TMDL.

Response: In the reports for which this comment is applicable, the TMDL calculations have been revised so that these loads are added to the WLA portion of the TMDL (same as LDEQ's procedure). For most of the draft reports, the TMDL calculations already used LDEQ's procedure of adding the minor point sources to the modeled loads.

17. Proper justification must be provided when using a nonpoint source margin of safety value other than the typical LDEQ value of 20%.

Response: The nonpoint margin of safety (MOS) was set to 10% based on other TMDLS on southern Louisiana waterbodies that have either been developed by LDEQ or approved by LDEQ. Eleven TMDL reports from LDEQ's website were reviewed to examine the explicit MOS for nonpoint sources. All 11 of these TMDLs were for oxygen demanding substances in the Mermentau or Vermilion-Teche basins. The explicit MOS for nonpoint sources was set to 20% for 2 reports, 10% for 3 reports, and 0% for 6 reports. Therefore, the value of 10% was considered to be a typical value that did not need special justification.

18. LDEQ has major concerns relating to the use of a one dimensional steady state model in coastal bays, lakes and estuaries. These systems are typically dominated by tides and winds and do not behave like riverine systems. LAQUAL can be used to simulate estuarine systems with riverine characteristics and some tidal influences; however to use it in these applications exceeds the model's recommended input limitations and appears to produce a meaningless output. Also the systems' unique hydrological characteristics do not adapt well to LAQUAL's one-dimensional capabilities. A multi-dimensional model such as WASP should be used for these waters. While a dynamic model would be preferred, a steady-state multi-dimensional model would be acceptable if it adequately addresses tidal influences. LDEQ objects to the use of LAQUAL in determining TMDLs for coastal bays, lakes and estuaries.

Response: A one dimensional steady state model such as LAQUAL was considered to be appropriate for all of these subsegments based on the amount of data that were available. Proper application of a multi-dimensional model or a dynamic model would require much more data and is simply not necessary for these waterbodies. For large, wide waterbodies, WASP will yield the same results as LAQUAL if the configuration of elements and model coefficients are the same between the two models.

19. The report uses the term synoptic survey multiple times. Please describe in detail what area this survey encompassed as well as site locations and what parameters were tested. Also, the raw data from this survey must be included in the appendices as support for the model inputs and calculations.

Response: A description of the synoptic survey and a summary of the data have been added to the appendices for each report in which those data are used.

20. In many of the calibration models the average water quality data from several LDEQ stations were used. It has been LDEQ's experience that a better calibration can be accomplished by using a single day's water quality and flow data. The additional daily values could then be used to perform multiple verifications of the model parameters before proceeding to the projection

stage. The flow data should be collected at the same time as the water quality data in order for the model to be valid.

Response: The models were calibrated to averages over multiple sampling events to minimize the effects of any single field measurement that might be of questionable quality or indicative of conditions that may have lasted only a very short time. For large systems with long residence times, using only a single snapshot of water quality data is often not representative of steady state conditions for that system.

21. Grammatical errors and misspelled words were found in these reports.

Response: The reports have been reviewed for grammar and spelling.

22. There does not appear to be any significant anthropogenic source of nutrients from agriculture, silviculture, aquaculture or urban runoff in many of these subsegments. Therefore, any occurrence of low DO is almost certainly natural. As a result, a UAA for the area is necessary to reset the DO standard. A TMDL is unwarranted for these subsegments,and LDEQ takes exception to EPA generating TMDLs which are impossible to implement.

Response: EPA is required to generate these TMDLs based on the Modified Court Ordered 303(d) List and the requirements of Section 303(d) of the Clean Water Act and regulations at 40 CFR 130.7.

23. LDEQ's nutrient standard is based on total phosphorus (TP) and total nitrogen (TN), not total inorganic nitrogen (TIN). Since phosphorus is not the limiting constituent in Louisiana, the nutrient allocations must be in terms of TN and only TN.

Response: LDEQ's nutrient standard (LAC 33:IX.1113.B.8) does not specify that nitrogen to phosphorus ratios should be based on total nitrogen. However, EPA will consider this in future development of TMDLs in Louisiana.

In the coastal areas, the nitrogen to phosphorus ratio used was based on freshwater streams and is not applicable to brackish Gulf waters. LDEQ takes exception to the calculation of a TMDL based on TN/TP ratios derived from waterbodies other than the modeled waterbody. It is LDEQ's experience that the natural allowable TN/TP ratio is waterbody-specific and can vary dramatically between streams.

Response: EPA agrees that it would be ideal to have a large database of nitrogen to phosphorus ratios for each waterbody. However, because these subsegments have only limited nutrient data, the previously developed nitrogen to phosphorus ratio that was used in the draft reports is considered acceptable.

LDEQ has not adopted the EPA recommended ammonia criteria (1999) and takes exception to its use in this TMDL. In general, LDEQ does not accept EPA's use of national guidance for TMDL endpoints. The nationally recommended criteria do not consider regional or site-specific conditions or species and may be inappropriately over protective or under protective. No ammonia nitrogen toxicity has been demonstrated or documented in any of the waterbodies in these TMDLs. The general criteria (in particular, LAC 33:IX.1113.B.5) require state waters be free from the effects of toxic substances.

Response: Ammonia TMDLs were developed for two subsegments based on the requirements of Section 303(d) of the Clean Water Act and regulations at 40 CFR 130.7 and the fact that the Modified Court Ordered 303(d) List included ammonia as a suspected cause of impairment for those two subsegments. National guidance for ammonia toxicity was used in the absence of any numerical state water quality standards for ammonia.

24. The implicit margin-of-safety must not be quantified.

Response: The text of the reports has been revised to eliminate any quantification of the implicit margin of safety.

25. EXECUTIVE SUMMARIES: Add summary tables of the WLAs, LAs, and TMDLs showing the allocations and margins of safety.

Response: The summary tables of the WLAs, LAs, and TMDLs can be easily found in Section 5 of each report and do not need to be repeated in the executive summary.

26. Temperature Correction of Kinetics: A temperature correction factor was set for reaeration. It is LDEQ's standard practice to allow LAQUAL to calculate this factor. There is more guidance on this in the LAQUAL User's Manual.

Response: The temperature correction factor was reaeration was set to the value of 1.024 based on guidance in Section 3.3.8 of the LTP.

27. Water Quality Kinetics: The Louisiana reaeration equation was used on reaches that are outside the maximum depth that it was designed for. A more appropriate reaeration equation must be selected.

Response: The Louisiana equation yielded reaeration coefficients that appeared more reasonable than coefficients from other equations.

28. Water Quality standards and designated uses tables did not include the BAC (bacterial criteria) values.

Response: The water quality standards for bacteria are not relevant for these TMDLs.

29. The statement was made in the Initial Conditions paragraphs in several of the reports that temperature was specified because the temperature was not being simulated. The section then states, "For constituents not being simulated, the initial concentrations were set to zero …". Initial conditions provide a starting point for the iterative solution of modeled constituents. They also provide values for constituents that are needed as input but are not being simulated.

Response: EPA appreciates this comment.

30. Several reports describe the benthic ammonia source rate as a calibration parameter; however a review of the data type 13 calibration input section indicates a value of zero for this parameter, in all reaches.

Response: The benthic ammonia source rate was used as a calibration parameter; the value of that parameter that provided the best fit between predicted and observed values was zero.

31. Calibration, and Projection, Data type 27: A salinity value was set to zero in the boundary conditions for both the calibration and the projection models in several of the TMDLs. With this value set to zero the model will automatically adjust the values of the lowest reach's elements to the value set in the boundary conditions. Since most of the models were one-reach, one-element models, the model automatically set the element salinity to zero, thus calculating an inaccurate value for the DO saturation.

Response: The only models where salinity was set to zero in the downstream boundary conditions were those models where salinity was not considered high enough to have a significant impact on DO saturation.

32. It is not LDEQ's standard procedure to use a zero headwater flow. You may not have input a headwater flow, but the model did. Without a headwater flow the model would have crashed and not run. The model's programming allows for a 0.0000001 cms flow rate when the modeler has not input a headwater flow.

Response: Only two simulations (calibrations for Spanish Lake and Big Constance Lake) used a zero headwater flow. For all practical purposes, 0.0000001 m3/sec is the same as zero flow.

33. Hydraulics and Dispersion: The use of constant widths and depths requires proper justification.

Response: The widths and depths were justified in Section 3 of each report.

34. Several reports state that algae were not simulated because algae did not appear to have significant impacts. What was the evidence for this statement? Did the contractor have any Chlorophyll a measurements?

Response: This statement was based on general knowledge of the Mermentau and Vermilion-Teche basins as well as a limited amount of diurnal DO data collected in these basins.

SPECIFIC COMMENTS FROM LDEQ FOR LAKE ARTHUR, GRAND LAKE, AND GULF INTRACOASTAL WATERWAY:

1. 2.4 Previous Data and Studies, page 6: Site #6 appears to be well outside the model area and its water quality should have no bearing on the subsegments included in this TMDL.

Response: This site was listed for information purposes only.

2. Figure 3.1, page 7: Certain reaches have discrepancies when compared to the calibration model input sets. Reach 8 is listed as "J2" in the figure and as "J3" in the model input. Reach 4's description does not correlate to any of the other two digit reach labels.

Response: The ID for reach 8 has been changed from J3 to J2 in the model. This has no effect on the model output.

3. Figure 3.1, page 7: The width and length values listed in reach 9 could not be verified with the satellite imagery mapping available to LDEQ.

Response: The width and length multiplied together yield a surface area of approximately 58 square miles, which appears to be correct.

4. 3.2 Calibration Period, page 9, paragraph 2: The Julian days listed as "235 to 265" should be "236 to 296".

Response: The Julian days have been corrected.

5. 3.4 Hydraulics and Dispersion (Data Types 9-10), page 10, paragraph 2: The contractor chose a numeric dispersion factor based on the value determined in the Bayou Lacassine model (FTN, 2000a). The LDEQ ambient data includes chlorides, sulfates and other known conservatives. This data should have been used to determine the dispersion factor during the calibration process.

Response: There was not sufficient data to calibrate the dispersion factor using the LDEQ ambient monitoring data. These data were collected at stations that are very far apart and at two week intervals. Also, some of the subsegments were sampled on alternate weeks from the other subsegments.

6. <u>3.6 Water Quality Kinetics (Data Types 12-13), page 10, paragraph 6</u>: It is stated that the average daily wind speed used in the wind aeration equation was adjusted from the airport's ten meter height value to a one meter height value. LDEQ suggests that a 0.1 meter height would be more appropriate and consistent with previous LDEQ TMDL's.

Response: Several literature sources have been reviewed and no published recommendation has been found for what height the wind speeds should be adjusted. A height of one meter was considered to be acceptable for these TMDLs. EPA will consider this in future development of TMDLs in Louisiana.

7. <u>3.8 Headwater and Tributary Flow Rates (Data Types 20 and 24), page 12, paragraph 2</u>: The headwater flow used in the calibration model was determined from the Mermentau River USGS station at Mermentau. Below the USGS station and above Lake Arthur is a major tributary, Bayou Queue de Tortue. In the summer projection model for the Mermentau River the Bayou Queue de Tortue flow was a major contributor to the total flow discharging to Lake Arthur. An estimate of its flow should be included in the calibration.

Response: This flow has been included for both the model calibration and the projection.

8. <u>3.8 Headwater and Tributary Flow Rates (Data Types 20 and 24), page 12, paragraph 2</u>: An average flow was used in this calibration. Due to the high peak flows skewing the average, it is not generally acceptable to use an average flow value over long periods of time. A median value is more widely used in those situations. In this case the difference between the two is dramatic, the average value used was 1669 cfs while the median value was 541 cfs.

Response: The average flow was used in order to represent the total loading of pollutants to the system during the calibration period. There is no universally accepted guidance for using the median versus the mean.

9. <u>3.8 Headwater and Tributary Flow Rates (Data Types 20 and 24), page 12 & 13, paragraph 6</u>: If some of the inflow to the Grand Lake system is being lost to evaporation, it would be appropriate to account for the loss in volume. Since the pollutant loading will not decrease with evaporation loss, the model can be used to estimate the concentration changes due to these losses.

Response: The concentration changes due to evaporative losses are minor.

10. <u>3.9 Headwater and Tributary Water Quality (Data Types 21 and 25), page 13, paragraph 5</u>: The terms described in the ratios appear to be out of order. Using the order currently listed would give a different equation than the one listed below the paragraph.

Response: The text has been corrected to state that 6.0 was the ratio of TOC to CBOD5, not vice versa.

11. <u>Calibration, Data type 19</u>: Why are there such large discrepancies in the loads between reaches 1 & 2 and reaches 5 & 7. These are similar reaches and such variations must be justified in the model report. The SOD values for these respective reaches are identical, which strengthens the question as to why there is such a large difference in the reach benthic loads.

Response: These loads were used as calibration parameters. It is not known exactly why the loads are different between reaches.

12. <u>Projection, Data type 3</u>: Why wasn't the K_L minimum adjusted for the average critical season wind speed. It appears that the value was just carried over from the calibration model.

Response: Using the same KL for the calibration and projection was considered acceptable for these TMDLs. However, EPA will consider this in future development of TMDLs in Louisiana.

COMMENTS FROM LDEQ PRIOR TO PUBLIC COMMENT PERIOD:

1. <u>Executive Summary, page 2, paragraph 1 and Water Quality Standards, page 4, paragraph 2</u>: LDEQ does not currently support or follow the 1999 EPA guidance concerning ammonia criteria and takes exception to its being used in this TMDL.

Response: See response to second part of comment 23 from LDEQ General Comments above.

2. The report uses the term synoptic survey multiple times. Please describe in detail what area this survey encompassed as well as site locations and what parameters were tested.

Response: A description of the synoptic survey and a summary of the data have been added to the Appendix C.

3. In the calibration model an average of the flows and water quality data from several LDEQ stations were used. It has been LDEQ's experience that a better calibration can be accomplished by using a single day's water quality and flow data. The additional daily values could then be used to perform multiple verifications of the model parameters before proceeding to the projection stage.

`Response: See response to comment 20 from LDEQ General Comments above.`

4. Numerous grammatical errors and misspelled words were found in this report.

`Response: The report has been reviewed for grammar and spelling.`

5. <u>2.4 Previous Data and Studies, page 6</u>: Site #6 appears to be well outside the model area and its water quality should have no bearing on the subsegments included in this TMDL.

`Response: See response to comment 1 from LDEQ Specific Comments above.`

6. <u>Figure 3.1, page 7</u>: Certain reaches have discrepancies when compared to the calibration model input sets. Reach 8 is listed as "J2" in the figure and as "J3" in the model input. Reach 4's description does not correlate to any of the other two digit reach labels.

`Response: See response to comment 2 from LDEQ Specific Comments above.`

7. <u>Figure 3.1, page 7</u>: The listed width values do not match the actual widths in the calibration model output. The differentials are small, however, for consistency the values should match.

`Response: The differences are due to round-off when specifying velocity coefficients rather than width coefficients in data type 8.`

8. <u>Figure 3.1, page 7</u>: The width and length values listed in reach 9 could not be verified with the satellite imagery mapping available to LDEQ.

`Response: See response to comment 3 from LDEQ Specific Comments above.`

9. <u>3.2 Calibration Period, page 9, paragraph 2</u>: The Julian days listed as "235 to 265" should be "236 to 296".

`Response: See response to comment 4 from LDEQ Specific Comments above.`

10. <u>3.3 Temperature Correction for Kinetics (Data Type 4), page 9, paragraph 4</u>: The temperature correction for reaeration is listed as 1.024. It is LDEQ's standard procedure to allow the LAQUAL model to calculate this temperature correction factor

`Response: See response to comment 26 from LDEQ General Comments above.`

11. 3.4 Hydraulics and Dispersion (Data Types 9-10), page 9, paragraph 5: The contractor could have accomplished the same modeled width and depth values by choosing the specified width and depth option in DataType 3, setting the coefficients to zero and inputting the estimated widths and depths as the corresponding constants into the two equations. The way chosen by the contractor is more arduous, leads to input errors and is more difficult for others to follow.

Response: The method that was used may not be the most efficient, but is acceptable. EPA will consider this in future development of TMDLs in Louisiana.

12. 3.4 Hydraulics and Dispersion (Data Types 9-10), page 10, paragraph 2: The contractor choose a numeric dispersion factor based on the value determined in the Bayou Lacassine model (FTN, 2000a). The LDEQ ambient sites data includes chlorides, sulfates and other know conservatives. This data should have been used to determine the dispersion factor during the calibration process.

Response: See response to comment 5 from LDEQ Specific Comments above.

13. 3.6 Water Quality Kinetics (Data Types 12-13), page 10, paragraph 6: It is stated that the average daily wind speed used in the wind aeration equation was adjusted from the airport's ten meter height value to a one meter height value. LDEQ suggests that a 0.1 meter height would be more appropriate and consistent with previous LDEQ TMDL's.

Response: See response to comment 6 from LDEQ Specific Comments above.

14. 3.6 Water Quality Kinetics (Data Types 12-13), page 11, paragraph 4: The contractor choose 0.02 per day as the Organic Nitrogen decay rate. LDEQ's concurs with Texas's TNRCC procedures that, without any available measured decay rates, this value should be set to a default of 0.05 per day. LDEQ's guidance has specified a default decay rate value of NBOD of 0.05 per day. The decay rate from organic nitrogen to ammonia is the restricting decay rate in the nitrogenous process, thus the NBOD rate should be approximately equal to the organic nitrogen decay rate.

Response: The value of 0.02/day for the organic nitrogen decay rate was consistent with published literature (EPA 1985) and has been used in other water quality models that have been approved by LDEQ for TMDLs for southern Louisiana waterbodies.

15. 3.6 Water Quality Kinetics (Data Types 12-13), page 11, paragraph 5: It is LDEQ's standard procedure to use the default nitrification inhibition option 2. The increase in ammonia nitrogen at the low DO values could be compensated for with algal or macrophyte inputs. Even with the less stringent inhibition option, the calibration for ammonia nitrogen was poor in the Sledge Canal, showing that there were additional processes occurring.

Response: See response to comment 10 from LDEQ General Comments above.

16. <u>3.8 Headwater and Tributary Flow Rates (Data Types 20 and 24), page 12, paragraph 2</u>: The headwater flow used in the calibration model was determined from the Mermentau River USGS station at Mermentau. Below the USGS station and above Lake Arthur is a major tributary, Bayou Que de Tortue. In the summer projection model for the Mermentau River the Bayou Que de Tortue flow was a major contributor to the total flow discharging to Lake Arthur. An estimate of it's flow should be included in the calibration.

Response: See response to comment 7 from LDEQ Specific Comments above.

17. <u>3.8 Headwater and Tributary Flow Rates (Data Types 20 and 24), page 12, paragraph 2</u>: An average flow was used in this calibration. Due to the high peak flows skewing the average, it is not generally acceptable to use an average flow value over long periods of time. A median value is more widely used in those situations. In this case the difference between the two is dramatic, the average value used was 1669 cfs while the median value was 541 cfs.

Response: See response to comment 8 from LDEQ Specific Comments above.

18. <u>3.8 Headwater and Tributary Flow Rates (Data Types 20 and 24), page 12, paragraph 3</u>: It is not LDEQ's standard procedure to use a zero headwater flow. The LTP recommends using 0.1 cfs flow in such cases for calibration as well as summer projection conditions.

Response: See response to comment 32 from LDEQ General Comments above.

19. <u>3.8 Headwater and Tributary Flow Rates (Data Types 20 and 24), page 12 & 13, paragraph 6</u>: If some of the inflow to the Grand Lake system is being lost to evaporation, it would be appropriate to account for the loss in volume. Since the pollutant loading will not decrease with evaporation loss, the model can be used to estimate the concentration changes due to these losses.

Response: See response to comment 9 from LDEQ Specific Comments above.

20. <u>3.9 Headwater and Tributary Water Quality (Data Types 21 and 25), page 13, paragraph 5</u>: The terms described in the ratios appear to be out of order. Using the order currently listed would give a different equation than the one listed below the paragraph.

Response: See response to comment 10 from LDEQ Specific Comments above.

21. <u>4.1 Identification of Critical Conditions: page 15, paragraph 5</u>: Instead of design flow LDEQ tries to use the anticipated flows where ever possible. Many times a facility's design capacity is much larger than its anticipated flow based on the number of homes within the community.

Response: Using design flow results in a more conservative TMDL.

22. 4.2 Temperature Inputs, page 16, paragraph 1: "Subsegments" is misspelled.

Response: This misspelling has been corrected.

23. 4.2 Temperature Inputs, page 16, paragraph 2: It is LDEQ's practice to run both a winter and summer projection. The addition of a winter projection run is required.

Response: See response to comment 11 from LDEQ General Comments above.

24. 4.5 Nonpoint Source Loads, page 17, paragraph 5 and 4.8 Model Results for Projection, page 18, paragraph 4:

A. The percent reductions for the non-point were very selective and variable. LDEQ attempts to apply the same percentage reduction to similar land use types within the model area.

Response: See response to first part of comment 4 from LDEQ General Comments above.

B. Much of the nonpoint loading affecting these subsegments and adding to their benthic blanket is coming from the tributaries feeding them. Most of these headwater tributaries have recent TMDL's that require dramatic percentage reductions to the nonpoint contributions. By implementing the reductions to nonpoint loads upstream, the current problems in these lower subsegments will be reduced. Most of the land in the vicinity of the lower subsegments is marsh where a reduction in nonpoint loads is meaningless.

Response: See response to second part of comment 4 from LDEQ General Comments above.

C. A reduction in mass loads of ammonia nitrogen is described. In our review of the projection input dataset, the reductions being applied, are to the SOD, resuspended CBODu and resuspended organic nitrogen. It is recognized that the organic nitrogen does decay to ammonia nitrogen, however it would be more accurate to state what is actually being reduced.

Response: The benthic ammonia loads were not excluded from reductions for the projection; rather, they were already set to zero in the calibration. However, for clarity, the words "benthic ammonia source rates" have been deleted from the sentence in Section 4.5.

D. The percentage reductions listed, when checked against the calibration and projections input datasets, were calculated incorrectly. These values did not take the MOS into consideration.

Response: See response to comment 5 from LDEQ General Comments above.

E. LDEQ's policy is to address background loads. It is also LDEQ's policy to make a No-Load projection run which requires the estimation of these background loads. The contractor should include a No-Load projection run in this model report.

Response: See response to comment 11 from LDEQ General Comments above.

25. <u>5.0 DO TMDLs, page 19, paragraph 4 & 5</u>:

A. A default 0.001 MGD flow rate was assigned to dischargers where a flow rate was not available. This default flow rate is extremely low and could strictly limit these dischargers allowable permit loads when their permits are renewed. Additional research should be done to determine the facility type and anticipated flow rates of these facilities.

Response: See response to comment 15 in LDEQ General Comments above.

B. LDEQ takes exception to the equating of COD to CBODu. There is no data to support this assumption. No direct correlation has been drawn between these two parameters. The only correlations that have been found are variable and dependant on the type of discharge. LDEQ requests that these facilities with only COD limits be removed from the WLA load calculations.

Response: See response to comment 7 in LDEQ General Comments above.

C. LDEQ does not agree with the minor point sources' loads being subtracted from the NPS load. The pollutant loads being addressed in this TMDL are non-conservative loads. Many of these dischargers are located on small tributaries to the 303(d) waterbody and have recovered prior to entering into that system. Thus they are not contributing to the pollutant loads in the impaired waterbody. LDEQ's current procedure is to add these loads to the WLA portion of the TMDL.

Response: See response to comment 16 in LDEQ General Comments above.

D. Paragraph 5 was very difficult to follow and determine what load was the final LA. Also once a final LA is determined, it would need to be compared to the calibration NPS load to determine the true NPS percentage load reductions.

Response: This paragraph has been revised because the TMDL calculations have been revised so that the minor point source loads are now added to the modeled loads rather than subtracted from the NPS load allocation (see response to comment 16 in LDEQ General Comments above).

26. 5.3 Ammonia TMDLs, page 23, paragraph 2: LDEQ has not adopted the EPA recommended ammonia criteria (1999) and takes exception to its use in this TMDL. In general, LDEQ does not accept EPA's use of national guidance for TMDL endpoints. The nationally recommended criteria do not consider regional or site-specific conditions or species and may be inappropriately over-protective or under-protective. It should also be noted that the subsegment in this TMDL listed for ammonia nitrogen was based on evaluative information. As such, it should not necessarily be interpreted as impaired due to ammonia nitrogen toxicity. Additionally, no ammonia nitrogen toxicity has been demonstrated or documented in any of the waterbodies in this TMDL. The general criteria (in particular, LAC 33:IX.1113.B.5) require state waters be free from the effects of toxic substances. If there are no data to support toxicity problems due to ammonia nitrogen, an evaluative assessment for ammonia nitrogen could not be considered a violation of the State's general narrative criteria.

Response: See response to second part of comment 23 from LDEQ General Comments above.

27. 5.6 Margin of Safety, page 25, paragraph 2: The explicit MOS used for the non-point sources was 10%. When the MOS percent used is less than the LDEQ standard 20%, a justification statement should be made in the report.

Response: See response to comment 17 from LDEQ General Comments above.

28. <u>6.0 Sensitivity Analysis, page 25, paragraph 3</u>, Was the sensitivity analysis run against the calibration model or the projection model?

Response: The sensitivity analysis was run against the projection.

29. <u>Calibration, Data type 3</u>: No conservative was used. Chlorides or some other conservative should have been used to hydrologically calibrate the flows and dispersion.

Response: See response to comment 5 from LDEQ Specific Comments above.

30. <u>Calibration, Data type 19</u>: Why are there such large discrepancies in the loads between reaches 1 & 2 and reaches 5 & 7. These are similar reaches and such variations should be justified in the model report. The SOD values for these respective reaches are identical, which strengthens the question as to why there is such a large difference in the reach benthic loads.

Response: See response to comment 11 from LDEQ Specific Comments above.

31. Projection, Data type 3: Why wasn't the K_L minimum adjusted for the average critical season wind speed. It appears that the value was just carried over from the calibration model.

Response: See response to comment 12 from LDEQ Specific Comments above.

GENERAL COMMENTS FROM LOUISIANA STATE UNIVERSITY (LSU) AG CENTER
(some of these comments may not apply to this report):

Through this letter the Louisiana State University AgCenter would like to submit official comments on TMDLs for dissolved oxygen and nutrients associated allocations for waterbodies in:

- Vermilion River Cutoff
- Bayou Chene
- Bayou Petite Anse
- Bayou Tigre
- Big Constance Lake and Mermentau Coastal Bays and Gulf Water
- Charenton Drainage and Navigation Canal and West Cote Blanche Bay
- Chatlin Lake Canal/Bayou Du Lac and Bayou Des Glaises Diversion Channel
- Dugas Canal
- Franklin Canal
- Freshwater Bayou Canal
- Irish Ditch/Big Bayou
- Lake Arthur, Grand Lake, and Gulf Intracoastal Waterway
- Lake Peigneur
- New Iberia Southern Drainage Canal
- Spanish Lake
- Tete Bayou
- Bayou Carron
- West Atchafalaya Basin Protection Levee Borrow Pit Canal

The number of different TMDLs sent out for comment at the same time may overwhelm the public's ability to comment. With only 30 days to prepare and submit comments it is impossible for a qualified faculty member to review the supporting data in depth and attend to his(her) official responsibilities. I realize that the agency is under time constraints on completing these, but I earnestly request that more time per proposed TMDL be given in the future.

We must make several other general comments and objections that apply to most of the proposed TMDLs. In many cases the data used to calibrate the models for the stream segments was collected in the fall of 2000 near the end of a three year drought. Historic low flows were often commented on in the text of the TMDL. Low flows result in a biased estimate of the natural ability of the stream to reaerate and cleanse itself of pollutants. Low flows also enable the benthic blanket to accumulate and remain in place undisturbed causing overstatement of the benthic oxygen demand and the SOD which were in many cases the primary oxygen demand loads in the stream. While it is true that the high flows that come from storm events carry more organic and sediment loads into the stream, the high flow rates also scour material from the bottoms and move it on to a final deposit at the stream terminus. It was thus that most of Louisiana and all of our coastal areas were built. Prolonged drought conditions do not allow this natural cleansing to occur. Thus it is our belief that the part of the oxygen demand load attributed to benthic and sediments is overstated and that new data must be collected during normal rainfall conditions and the models re-calibrated.

Response: The Louisiana water quality standards are applicable during all flow conditions greater than the 7Q10. Because 7Q10 flow is frequently the most critical condition for maintaining the DO standard, it is desirable to collect field data for model calibration during times when the hydrology is as close as possible to 7Q10 conditions. It is believed that the flow conditions for these waterbodies may have been near 7Q10 conditions, but probably not lower than 7Q10 flows. Therefore, the summer-fall 1998 data is desirable for model calibration.

In far too many of the proposed TMDLs the phrase *"an intensive field survey was not conducted for the study area due to schedule and budget limitations"* was found. If municipalities, agriculture, and business entities are to be asked to make large commitments of funds, time and effort to resolve our water quality problems they deserve to have the benefit of a serious study of the problem. We request that all of the proposed TMDLs that contain this statement have this problem corrected and that TMDLs be prepared based on complete studies.

Response: There is no requirement for collecting a certain amount of data to make a TMDL valid. If additional data are collected in the future by LDEQ, other agencies, or local stakeholders, then those data can be evaluated at the time and the implementation of the TMDL can be altered as necessary. As outlined in the 1991 EPA document titled "Guidance for Water Quality-Based Decisions: The TMDL Process", developing and implementing TMDLs is a process and not a one-time event.

In several of the proposed TMDLs data was used that is 9 or 10 years old from studies on point source discharges. While the data is probably high quality it assumes that no change in the plant or its load have occurred in the last decade. This assumption may not be defensible. In the TMDLs where a treatment plant was included in the model the margin of error was calculated by using 125% of the design capacity. This assumes a plant will perform at the same level when it is operated in excess of its design load. This assumption is also questionable.

Response: For several subsegments, old data sets were used for calibration because they provided more extensive data than newer data sets. However, all of the projection runs simulated point source discharges based on the most recent information available. Simulating point source discharges at 125% of design flow is simply a way of incorporating an explicit margin of safety and does not assume that the facility can actually treat that much wastewater.

The standard for dissolved oxygen (DO) was held at 5 mg/L in some steams on a year round basis, even if it received or discharged into a stream with 5 mg/L winter and 2 or 3 mg/l summer standards. Other streams had a year DO oxygen standard of 4 mg/L. We strongly suggest that a review be made of the DO standards for all of the streams in south Louisiana that are shallow, sluggish, and subject to tidal influence and that uniform standards be set. In view of the remarks that achieving a DO of 5 mg/L was impossible in some of the streams that had little loading from human activities, we believe that the summer standard of 2 mg/L is much more applicable to these streams.

Response: The TMDLs are required to be developed for the existing DO standard, which is 5 mg/L year round for many of these subsegments. If the DO standard is revised in the future for any of these subsegments, the TMDL and implementation can be altered as necessary as part of the TMDL process.

Many of these TMDLs were drafted by an out of state contractor and do not appear to be as well researched as those drafted by LDEQ. Very little data was included in the contractor drafted TMDLs summaries as compared to the ones prepared by or in conjunction with LDEQ. Additionally, the bulk of the text appeared to be standard wording in all documents with short relevant inserts. We would request that if outside contractors be used in future TMDL assessments that they be held to the same standard of information inclusion that LDEQ provides. Stream diagrams and maps are often needed when reviewing descriptive text on stream location, tributary insert, and exact location.

Response: These TMDLs contain all the required components of a TMDL and the level of detail is considered acceptable. Because these TMDLs could not be funded at the same level as most of LDEQ’s DO TMDLs, the analysis and documentation was not as extensive as most of LDEQ’s DO TMDLs. However, some of the information that was mentioned in the comment (stream diagrams and maps) was included in the reports, but they were placed in the appendices (which were available from EPA upon request).

SPECIFIC COMMENTS FROM LSU AG CENTER FOR LAKE ARTHUR, GRAND LAKE, AND INTRACOASTAL WATERWAY:

Lake Arthur and Grand Lake are broad shallow lakes at the terminus of a large drainage system and in the course of natural succession should be filling in with sediment and organic matter washed down from up stream. As indicated by the SOD they both appear to be following the natural course of events. Depth, reaeration, and velocity are the most responsive elements in the sensitivity analysis on the DO content, indicating that the major factors in increasing DO may be beyond human intervention. Reducing waste load flow and waste load BOD may effect some increase in DO, but the major factors here may droppings from the large resident and migratory waterfowl populations especially in Grand Lake and the Eastern Intracoastal waterway where there is very little human activity. A revision in the DO standard is obviously needed.

Response: EPA appreciates the comment.